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INVESTIGATION OF ELECTROSTATIC DISCHARGES

In this issue we print a second installment of the interesting microscopical investigation of Mr. Geo. T. Hanchett into the nature of electrostatic discharges. While thus far the results have not enabled any definite conclusions to be formed, the data collected are of interest, and subsequent experimental developments may give them a considerable significance, as indicated by the author. It would appear, however, that the effects noticed do not necessarily imply any definite flow, as they can be merely polar phenomena, though by their appearance seemingly indicating a flow.

ELECTROLYSIS OF UNDERGROUND PIPES BY TROLLEY CURRENTS

In another column Mr. Maurice Hoopes contributes an interesting discussion on various systems of connections for reducing or obviating electrolysis of underground piping by trolley ground currents. Owing to a blunder of the engraver, which was discovered too late to be remedied, some of the diagrams are not so clear as they should be, but the explanations in the article will enable them to be understood. As will be seen, the method to be adopted for a particular case is a matter depending upon the circumstances of that case, including a consideration of first cost. Though a system may be selected on general principles and applied to a road while under construction, the actual conditions influencing electrolysis are apt to be so difficult of à priori determination that there is a strong probability of subsequent changes or additions being necessary, the indications for these being furnished by the results of a careful survey under normal running conditions. In most instances at present what protection may be thought necessary is applied when the need has plainly showed itself after the road has been operated; in the future, however, it is probable, as the result of greater familiarity with the question, that a study will determine what system is most likely to meet a specific case, which will then be applied while the road is building, and the necessary changes above referred to made subsequently. Even then the problem cannot be considered definitely solved, as a different distribution of traffic, the opening of other electric lines, or the laying of new lines of piping may necessitate material changes. In fact, the question of electrolysis is one that the street railway engineer may always expect to have before him.

THE INVENTION OF THE ELECTROMAGNETIC TELEGRAPH.

At irregular intervals extending over a period of 40 years or more, the invention of the electromagnetic telegraph has been the subject of controversies, which frequently have been bitter in tone and thus far almost entirely fruitless so far as relates to any permanent settlement of the question. Among the reasons for this unsatisfactory state of affairs has been the intense personal bias of many of those taking part in the controversy, and the disconnected manner in which it has been carried on. With a view to definitely settling as far as that may be possible the relative status of the various claimants to honors in connection with the invention, THE ELECTRICAL WORLD will shortly begin the publication of a series of articles from the pens of recognized authorities, who will treat the matter in a dispassionate spirit and with reference only to the facts involved. Among those who will contribute to the discussion will be the two leading telegraphic authorities of the United States, whose articles will commence the series. Following will be articles giving the English, French and German views of the case, each by a writer of recognized authority in his respective country. The concluding articles, several in number, will be in the nature of

rejoinders and deal with the facts brought out in the main article, The five leading articles have been under preparation for some months, and will contain the results of an exhaustive study of every side of the question, and bring forth for the first time a number of interesting points bearing on the early history of telegraphic invention. The series will be profusely illustrated and will not only form a contribution of permanent value to telegraphic history, but will also, we trust, definitely end a discussion which has given rise to much bitter feeling. It was the intention to begin the publication of the series simultaneously with the Morse Commemoration, but the preparation of the cuts will necessitate a delay of several weeks.

THE BERLINER DECISION.

The reversal by the United States Circuit Court of Appeals at Boston last Saturday of Judge Carpenter's decision annulling the Berliner telephone patent, adds another to the legal sensations that have been so plentiful the last several years in connection with electrical patent litigation. That the action of the Circuit Court of Appeals involves a miscarriage of justice will, we believe, be the verdict of the general public, and there is much apparent reason to sustain this view. The two points made by Judge Carpenter against the Berliner patent were that the delay of 14 years in its issue was a fraud on the public, and that the 1880 Berliner patent, now expired, covered the same invention described in the subsequent patent granted in 1891—either of which considerations, he decided, voided the patent. In support of the former view Judge Carpenter cited at length the history of the numerous delays in the Patent Office, and while the Court of Appeals may not have found technical evidence of design in these delays, yet we fear that the public will be inclined to consider the case as another example of how justice may be perverted, not only in face of the law, but through its very assistance. As the opinion of the appeal judges has not yet been handed down, it is difficult to surmise on what grounds they based their action with respect to the above point, and their reasons will be looked forward to with much interest. As to the probable view of the Court with respect to the second point, an opinion may be hazarded. Assuming that the Court admitted that the Berliner patent of 1880 anticipated the invention for which a patent was granted 11 years later, they yet might not admit that the government had therefore a right to annul the second patent. If it were considered that Berliner had prosecuted diligently and within legal bounds his application for the later patent, it might be held that the government had no right to annul that patent when once granted, upon the grounds that it had made a mistake in consenting to its issue. This view, of course, is based upon the supposition that no fraud were proved by the government, as in any case fraud would be a sufficient reason for annulment. A very important consequence of this point is that while it would prevent the government from pleading prior invention, it would not prevent an alleged infringer from doing so. There is, therefore, a hope that though the government is powerless through the recent decision to annul the patent, the second point made by Judge Carpenter may yet be availed of by the public to have it declared invalid. In this latter case a suit might soon be brought to a hearing and a speedy decision reached. Otherwise the only chance of relief is through the Supreme Court sustaining the view of Judge Carpenter, should the case be taken before that body. This appeal cannot be claimed as a right, but it is probable, owing to the great public interests at stake, that the case will nevertheless be brought before the Supreme Court, and at the earliest possible day. In the meantime, the Berliner principle, which is claimed to cover every form of battery transmitter, is again in force, and the American Bell for the time being is as secure in its monopoly in certain respects as it was in its palmiest days. This monopoly would extend to the year 1908 provided the expiration of no foreign patent intervenes to shorten the term, and at present there is no knowledge, as far as we are aware, of the existence of such a patent.

The Work of the Cooper Union Night Schools.

The night schools of the Cooper Union have for 25 years furnished to the men and women of New York City who are unable, through lack of means or time, to pursue a collegiate course elsewhere, an opportunity to acquire a mathematical and scientific education such as would fit them to find employment in engineering, architectural or other professional work.

Hosts of ambitious men and women have availed themselves of the opportunity thus offered to educate themselves while engaged in earning a livelihood, and many of the graduates of this school have taken high rank in the engineering profession, and are to-day filling responsible positions because of the help they obtained in the Cooper Union classes.

Generous as was Peter Cooper's gift to the working people of New York, however, and encouraging as are the results obtained, more could be accomplished with larger funds.

Progress has been so rapid in science and the industrial arts that it has been impossible to keep the facilities for instruction abreast of the times, hence an addition to the present collection of apparatus could materially enhance the usefulness of the school, particularly as regards the department of electricity. There is an entire lack of all apparatus for making electrical measurements, and, in fact, of anything to demonstrate electrical progress during the past 40 years.

The Cooper Union night school can do considerable toward meeting the pressing demand for instruction in physical and electrical science, the fact that Prof. W. A. Anthony is professor of physics being sufficient evidence as to the sterling character of the course, but it is beyond human ability to make the school fully effective without the aid of more modern appliances. Is there not some one interested in promoting the welfare of the seekers for scientific knowledge, who will help the cause by assisting to provide the latest types of apparatus and appliances for instruction?

The Court of Appeals' Berliner Decision.

The United States Circuit Court of Appeals at Boston, on May 18, handed down a decision in the American Bell telephone case, declaring the Berliner patent valid. Judge Carpenter, of the Circuit Court, on December 1, 1894, decided that the Berliner patent was invalid and ordered it to be delivered up for cancellation. The American Bell Company appealed, with the above result, which extends the life of the patent to 1908.

As will be remembered by our readers, the United States relied upon two grounds to show that the patent was void. The first was that there was illegal delay in its issue. The second was that a prior patent was granted upon the same application to the same applicant for the same invention. This prior patent referred to was one granted to Berliner in 1880. The decision of Judge Carpenter sustained these two grounds of attack made by the government against the patent, and held that it was void and should be delivered up to be cancelled.

The government has on file a motion to amend the bill, and alleging that in addition to the illegal delay in the prosecution of its application for a patent, the Bell Company had a tacit understanding with the officials of the Patent Office not to issue the Berliner patent pending the determination of the suits then pending over the Drawbaugh patent, which latter patent was claimed to be an interference. In view of this motion to amend, the government is given until May 25 to file its brief as to the form the judgment should take, while the Bell Company is given until May 31 to file its brief upon the same subject.

The opinion of the Court, which consisted of Judges Colt, Putnam and Nelson, will probably not be ready until about June 10, and therefore no one but the Court knows as yet what the grounds of the decision are. It is surmised that the reason the decision of the Court was rendered so unexpectedly was to prevent a premature knowledge of its conclusions getting out.

Lawyer Causten Browne, one of the counsel for the United States in the case, said that the case will be carried to the Supreme Court of the United States.

Some More Charges of Bribery.

Officials of the Westinghouse Company made a public statement on Thursday of last week to the effect that they had unearthed a conspiracy on the part of agents of the General Electric Company to obtain valuable information relating to the manufacturing business of the Westinghouse Company by bribing employees. The specific charge was that an employee of the Westinghouse Company named J. M. Van Cleve had been paid $25 for furnishing certain information to agents of the General Electric Company, and letters were shown addressed to E. G. Waters, the Pittsburgh manager of the latter company, which, it was claimed, substantiated the charge.

One of these letters is from the Philadelphia office of the General Electric Company, and signed by E. D. Mullen, manager. It states that the Schenectady office desires to find out "in any manner possible, even approximately," the Westinghouse output, weekly or monthly, of street railway motors, alternators, etc., and asks that the matter be taken up "promptly and energetically," and that every means within the Pittsburgh agent's power be used to secure said information. Another letter from the same source acknowledges the receipt of some information in regard to output and trouble with men in the Westinghouse Works, and adds "you have started well, and if you continue in like strain it will be a matter of a great deal of satisfactory information." A third letter is signed by William S. Beatty, and asks for a draft of $25 to pay Van Cleve for Westinghouse data.

Mr. Westinghouse, in discussing the question, said his company had not decided what steps to take in the matter, but the question was under consideration. He did not know what would be the best plan to pursue, but he felt that the matter ought to be called to the attention of the directors of the General Electric. He could not believe that they were aware of such actions on the part of their employees. "The tampering with employees, especially young men, at our works," he continued, "results in great harm. It is bribery to get information from them in this unfair way, and a violation of trust on the part of the employees to give out information about our works. When the conspiracy suit was up it was asserted that we were doing just what we charged the other people with doing. That was false. I will say this, that there is no place in our concern for a man who is susceptible to bribery for information, or who will adopt such methods as the General Electric people have used, to gain information for the benefit of our company. We wish to conduct our affairs in a business way without endangering the morals of the young men, who are allowed to get so much valuable training in electrical work in our shops. I think it a shame that young men should be subjected to such temptation. If they fall they cannot expect to get responsible positions with any business concern."

Mr. Waters replies to the above charges as follows:

"There is no manufacturing concern in this country that is not more or less interested in the capacity and output of its competitors. The Westinghouse Company has recently completed a factory for which some extravagant claims have been made as to capacity and output. These claims are the subject of common report among business men, as also are descriptions of considerable detail which have appeared, presumably with the authority of the Westinghouse Company, in various electrical trade journals. Having learned by previous experience that such reports and descriptions are not always the most reliable, it is true that some inquiries have been made to either prove or disprove these claims, as to capacity and output. This is positively all there is in the report, and I wish to state that absolutely no attempt has been made to obtain any information from the Westinghouse or any other company which could be considered of a secret or confidential nature, and nothing other was done than to verify reports as to capacity and output of the Westinghouse plant as published.

"In connection with Mr. Westinghouse's remarks in regard to tampering with employees, and the publication by him of letters which were surreptitiously removed from our files, it is a singular coincidence that upon arriving at the office this morning, I find upon my desk a letter from a heretofore trusted employee of this office stating that he left last night for the East, having accepted a lucrative position. We have known for some time that prices and other information valuable to our competitors have been escaping from our office here, but have been unable heretofore to place the responsibility."

Notes on Pipe Electrolysis.

BY MAURICE HOOPES.

Much has been said and written, recently, regarding damage to underground pipe systems by the action of electric railway currents. This has been mainly in the line of abstract theorizing as to the best means to adopt in order to arrest the damage to the pipes, although some contributions of a more practical nature have discussed concrete cases, giving analyses of the relative potentials throughout the rail and pipe systems, with comments regarding the probable actions that the currents were causing, and suggestions for, or statements of, alterations in the distribution systems with a view to lessening these actions. From no source, however, has there been information to show the results of changes made, and such information would consist, at best, of negative proofs of cessation of damage. In view of the existence of this condition of affairs, theorizing seems pardonable. The writer has found a graphical investigation of the subject to present the various phases in a clearer way than any other, and gives his analysis here, with the hope that it may result in discussion that will throw more light on the subject. The curves given are drawn arbitrarily, and not to be mathematically correct for any particular conditions.

Fig. 1 covers the general case of any simple distribution system. The ordinary system includes lines radiating in various directions from the generator. As these lines may be considered independently, and as each is similar to the others, it is only necessary to analyze the conditions existing in one. Furthermore, the consideration of the positive side of the system may be neglected, and attention given only to the negative conductors, consisting of rails and track wires. Figs. 2 to 9, therefore, contain only lines representing potentials in this part of the system. In these figures the point *P* represents the neutral point, at which pipes and tracks are at equal potentials, as determined before any connections have been made. The lines have the following values:

AB ——— Potential of track.
CD ····· " " pipes.
— · — · — · — · — " " — feeders.
····· " " track and pipes, coincident.
····· · ···· · ···· · ···· " " wires and pipes, "

In Fig. 1, consider *R* the armature of a generator, with the points 550 and 0 its positive and negative terminals; the line 550 to 500 the positive part of the distribution system of an electric railway, consisting of feeders and conductors; *r*, *r*, *r*, etc., armatures of car motors; *AB* the track circuit; *BO* the negative or track feeders. The potential of each point in the system is represented by its vertical distance above the point 0. The latter point is assumed to be at 0 potential, inasmuch as its potential is the lowest in the system. The other figures, 550, 500, 50, and 20, are assumed potentials of the points indicated. The arrows indicate the directions of current flow. *B* is the point where the feeders connect to the track. The pitch of the various lines indicates the fall of potential, and hence the current, in the conductors at the various points throughout their length, assuming cross sections of each, at all places, to be equal.

Fig. 2 presents a simple case where resistances of track and pipes are uniform throughout, and also that of the earth connecting them. Under these conditions, the areas *PCA* and *BDP* are equal, since the former represents the current flowing into, and the latter out of, the pipes. The line *CD* increases in pitch from *C* to *P* as the pipes get more current, and decreases from *P* to *D* as they lose current, being horizontal at *C* and *D*, where no current flows. *AB* increases from horizontal at *A* to maximum pitch at *B*. Obviously, track and pipes may be connected at *P* without affecting the potential relations, since no current will flow.

Fig. 3 represents conditions where the resistances of pipes and tracks vary, due to imperfect joints, the intervening earth also varying. This introduces additional neutral points. Practice shows these points ordinarily to be comparatively close to each other, and usually included within relatively small lengths of track. As in Fig. 2, track and pipes may be connected at *P*, *P'* and *P''*, without effect.

In the following figures it will be assumed, for convenience, that there is but one neutral point, *P*, and that curves are regular. Fig. 4 shows the effect of connecting pipe to wires at 0 and at no other points. These curves would be modified by changes in pitch of the track feeders, *OB*. Fig. 5 shows effect of connecting pipes, rails, and wires, at all points from *P* to *B* and *D*. Fig. 6 shows effect of connecting pipe to wires at all points from *7'* (formerly *P*) to 0. Fig. 7 shows effect of connecting rails, pipes, and wires, only at

point *P*. Fig. 8 shows effect of connecting rails and pipes at *P*, and feeders from 0 to *PB*, arranged to maintain constant potential along *PB*. Pipes and rails might be connected at all points from *P* to *B* and *D* without altering conditions. Fig. 9 shows effect of feeders from 0 to *AB*, arranged to maintain constant potential on *AB*. Pipes and rails might be connected at all points without altering conditions.

In the following discussion are considered both actions from current leaving pipes, and from current flowing in pipes, doing damage at high resistance joints.

From an inspection of the various curves shown it will be noted that Fig. 9 shows the ideal system, since the track is at a uniform potential throughout. With this, there is no current flowing to, from, or in, pipes. This could only be approximated in practice, however, and then only by means of the use of an enormous amount of copper (or heavy drops), and very careful feeder calculations. In this the capacity of the rail to carry current is not utilized, and hence its value as a return conductor is nothing.

Fig. 8 shows a method whereby current flow out of the pipes may be confined to the one wired connection at *P*, and flow prevented through pipes between *P* and the station, where the internal flow is usually heaviest. This demands a feeder system for uniform potential to that part of the track inside the neutral point; that is, between it and the station. In this there is no benefit derived from the current carrying capacity of the rail within the point *P*.

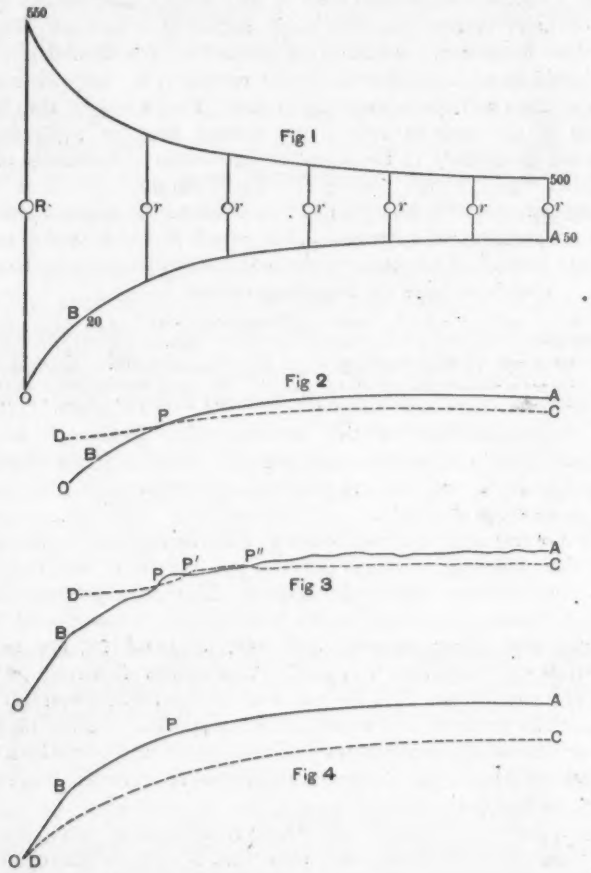
Fig. 7 shows the result of running track feeders to *P* only, and connecting there both to rails and pipes, and to neither, elsewhere. The result of this is to take all of the current from the pipes at *P* and to avoid any heavier internal flow than that normal in the pipes approaching *P*.

Fig. 4 shows that connecting the pipes to the station bus bar, at station, may accomplish the taking off of all the current through the wired connection, but that it then increases the amount of current in the pipes, since it depresses the potential of the pipe throughout its length, and makes it receive more current. As stated, the introduction of heavier track feeders, making *OB*, have less pitch, might throw part of *CD* above *AB*, and introduce the case of pipes positive to rail. This is a case for especial study, for each particular system.

Fig. 6 shows the effect of running special negative feeders to the pipes not connected to the tracks. This plan protects the pipes against action of currents leaving them, but greatly increases amount of current flowing into and through them. This method of connection is one that has been recommended as being the best one. Its disadvantages are obvious, however, and there seems to be no reason for its use. Fig. 5 shows the usual method of connecting rails and pipes to the same negative feeders. This protects the pipes from currents leaving, and gives greater or less trouble from currents flowing, as the drop from *P* to 0 is greater or less.

To determine, in general, the best method to use, it will be necessary to have data on the amount of damage ordinarily done to pipes by current flow in them, where the current is shunted round high resistance joints through the surrounding earth. If this is not greater than there is good reason to suppose it to be, it will be best, in ordinary cases, to use the method of connections shown in Fig. 5, since this utilizes the conductivity of the rails throughout their whole length. Should, however, the action at the joints be found to be considerable, it would be better to resort to the arrangement shown in Fig. 8. Fig. 7 shows a method that accomplishes everything that that in Fig. 8 does, excepting that there is a flow into and in the pipe from *D* to *P* in the former case, whereas there is none in the latter. This would be suitable where the track feeders were too few to allow uniform potential distribution to *PB*.

It has been held that any wired connection between pipes and rails or feeders necessarily increases current flow in the pipes, since it reduces the resistance of the pipe circuit; and hence is undesirable. A connection at the neutral point has no effect on the current flow, except that the neutral point shift and leave the connection where it will receive current. The latter contingency may arise with altered conditions of load and resistance of wires, rails, or pipes. It is probable, however, that the neutral point may be regarded as fixed, under ordinary conditions.



FIGS. 1 TO 9.

Electricity in Mills.

At Blies-Schweyen, near Saargemünd, says the London *Electrician*, a water-power generating station has been erected for the purpose of supplying current to adjacent works. The plant has a canal about a mile long, which supplies about 500 cu. ft. per second. The fall is 13.1 ft. There are three turbines of 200 horsepower each, which drive a main shaft. From this latter two 135-kw "drehstrom" generators of the Oerlikon type are driven by belts at 375 revolutions and give a potential of 2,900 volts. The exciters are coupled direct to each machine. The first consumer is a paper mill at Ensheim, about four miles from the power house. Here three 30-kw transformers are employed to reduce the E. M. F. to 120 volts, driving four motors and lighting the mill.

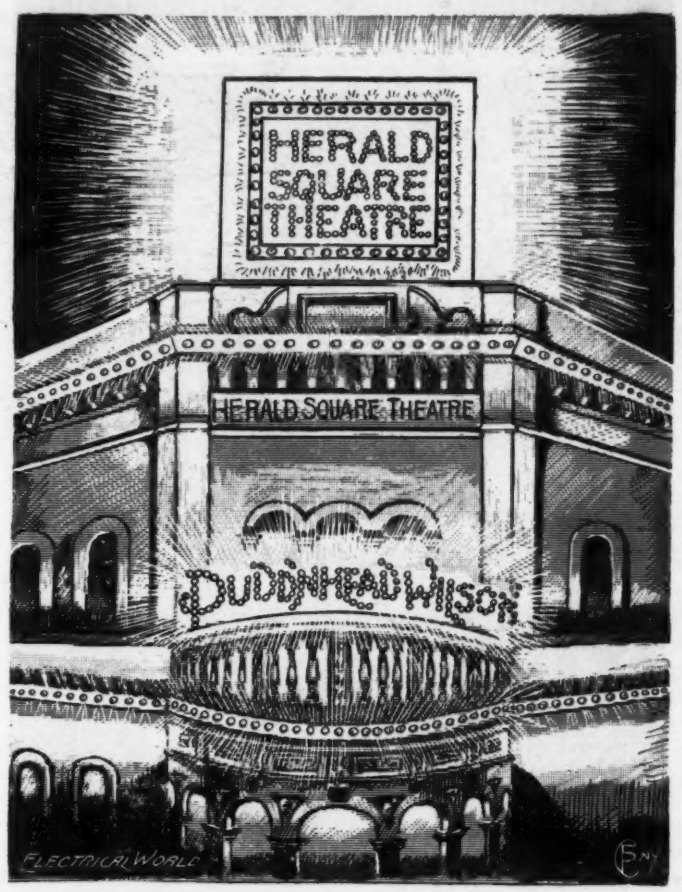
Signs of the Times.

THE recent ordinance which decreed that all the New York City theatres should remove their electric sign-boards from where they projected beyond the house line has very appreciably altered the nightly aspect of Broadway. To the observer standing on the 33d street "L" station, it used to seem as though a small bit of the Paris boulevards had dropped into New York. Innumerable specks and streaks of flame lighted up the street toward the south. The houses were outlined in light and the perspective distance was for once not lost in traditional darkness, but there converged to a centrally illuminated point. The genius of electricity might here have walked in triumphal procession along a fitly prepared highway. On all sides would have been evidence of his power. No other place in New York equalled it in effect.

But the Bureau of Incumbrances thought otherwise, and the projecting signs have all been swung in close against the house fronts. While this has altered the perspective view, yet if we walk along the thoroughfare we shall find enough evidence to convince us that electric house front decoration is the most valuable element in theatre advertising.

The Herald Square Theatre, formerly the Park Theatre, when remodeled had especial provision made in the way of electrical illuminated signs. A semi-portico or stationary awning, as it were, forms a part of the façade, the principal portion of which is on a corner. Running completely around the building on the upper edge of the portico is a line of 32-cp lamps, and a similar line runs along the edge of the roof. The peculiar formation of the eaves of the house offers an unusual chance for the beauties of light and shade to display themselves in the twistings and turnings of the architecture. The name of the theatre is highly wrought in painted letters below the upper line of light, but as though this were not enough to attract attention, an immense gilt frame studded with lamps adorns the roof. "Herald Square Theatre" is the flame picture displayed within the frame, and no one can pass it by without being impressed with the brilliancy of the display. In spite of the fact that the very name of the play conveys a warning of the sufficiency of "Johnson," the public gives the positive lie to the statement by demanding to see and hear the man in question over and over again. Hence "Too Much Johnson" is having a phenomenal run at the Standard Theatre, which seems to be very fortunate in the matter of long runs, so its electric signs are not so often changed as they might otherwise be. Every roof garden devotee in town knows of the long reign of "Johnson," for high above the roof of the Standard is an immense arrangement of incandescent lamps, spelling out the name of the play and that of its author and principal actor, Mr. Wm. Gillette. Mr. Miner was one of the few managers who did not have to conform to the ordinance. This was because he had long ago discarded a swinging transparency. People who pass his theatre, however, fully realize that it is there where Mr. Crane nightly depicts the weaknesses, foibles and other idiosyncrasies of the too loving parent in "His Wife's Father," for large and brilliant across the house front is the flaming truth made manifest. "Miner's 5th Ave. Theatre. His Wife's Father," is the precise wording of the sign. It is located above the doorway, just where it will give you a sufficient foretaste of what you may see within. Geometrical *fleur-de-lis* flank it on either side, and the incandescent lamps thereon add to the strength of the general effect. Located above the general sign are two arc lamps. From the doorway itself comes a flood of light, the long corridor of the theatre projecting it out to the sidewalk with a concentration worthy of a search lamp.

Perhaps it is because of the near proximity of the former "Queen



of Brilliants," but certainly the front of Abbey's Theatre, where Lillian Russell is singing "The Tzigane," is artistic in its effect, and with an extremely small amount of glare. The name of the songstress is "written" in Spencerian characters with incandescent lamps. With the exception of two arc lamps with fancy globes, this is the only decoration. It is the peculiar architecture that

really shapes the effect. The façade is complicated, the door sets deep into the wall, and heavy stone pillars stand in pairs at each side of the doorway. The arc lamps hang directly in front of the latter, the front surfaces of which are, at night, as light as day, while deep within their recesses is the blackness of night. The

capitals of the columns catch up the light or reject it, as may be, until the most artistic rendering is produced.

Something on the same order is the Empire Theatre, except that

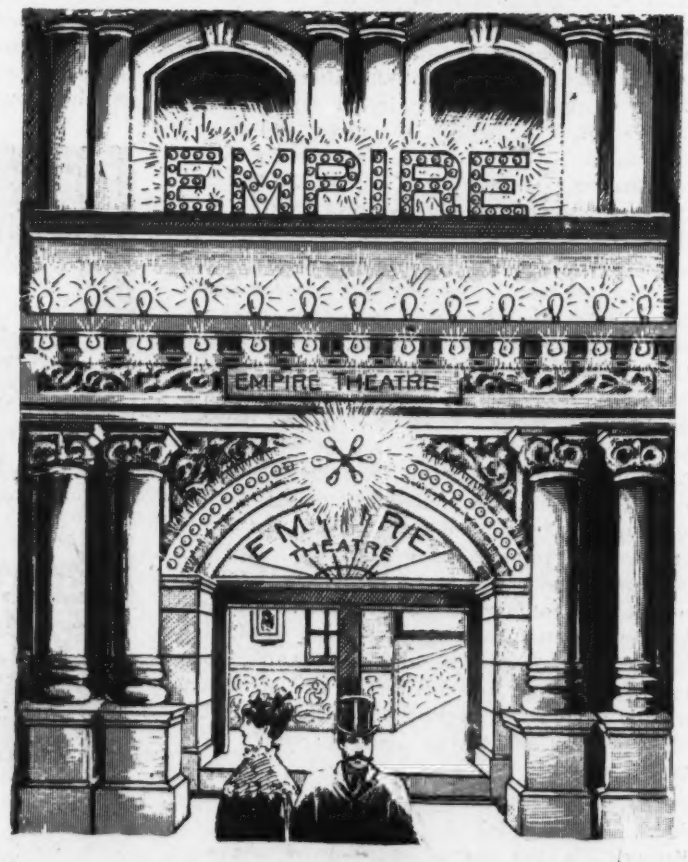
here the effect is much heightened because there is more of it. The columns are beside the doors, as at Abbey's, and the arc lamps are not here, incandescent lamps playing the whole part. A closely placed arch of them adorns the doorway, a line of them is arranged

on the façade, while others intersperse the cornice of the second story. The name of the theatre, "Empire," is spelled out in light above this cornice. The light from them flares upward and loses itself among the pillars above, reproducing in smaller measure the effect of the Abbey arrangement. Directly above the door "Empire Theatre" is to be seen in large letters fixed into the transom. In line with the arch of lamps is an ornamental bunch of lamps—a six-pointed star. Altogether the effect is very good.

But if these theatres are gorgeous in their raiment of light, there are others which, if more modest in their display, are yet worthy of mention. There is the Casino with its beautiful sign, or the American with two huge incandescent names across the roof. Every west sider has seen them from the "L" train. There is Tony Pastor's with its two rows of lamps leading out to posts on the sidewalk. Koster & Bial who use the top of a portico to support the

frame on which the lamps rest, have a sign of light, showing the name of the hall. In the way of electric effect, Keith's Fourteenth Street Theatre is well supplied. The front of the building is a huge transparency. Blue glass predominates, and behind it are bunches of lamps. But in front are rows of lamps arranged so as to particularly set off the architecture. The façade of the theatre is a kind of modernized, mongrel Moorish style, with various attempts at producing mosque-like formations and turrets.

Of course, Hoyt has a sign, and so has the Imperial Music Hall. The Eden Musée has surrounded an oblong granite slab, containing the name of the museum, with incandescent lamps, while a line of incandescent lamps runs across the building up near the roof.

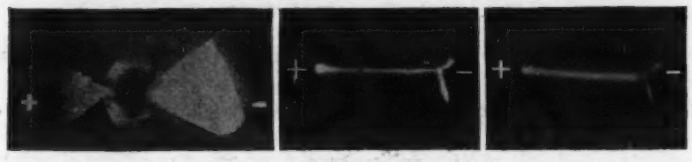


Proctor's Theatre is as fortunate as Keith's in its electric display. An extension of the lobby, or entrance, is built out on the sidewalk, which is full of lamps, and is utilized to display frames full of photographs of the performers within.

Microscopical Research in the Electrostatic Discharge.

BY GEO. T. HANCHETT.

In the last article on this subject, the writer spoke of an attempt to see whether the terminals between which an electrostatic discharge took place has a sensible loss or gain in weight. Since then the experiment has been repeated several times, and no difference can be detected even with a balance sensitive to $\frac{1}{100}$ mg. In one case the powdered tin foil lay about on the slide quite profusely, but no change in the weight of either terminal could be discerned. Fig. 1 shows the two terminals of this case. The dust must have been of the most subdivided nature in order to be so apparent to the eye, and yet be of negligible weight. It is interesting to note that this dust appears to be symmetrically laid, and most profusely at the positive pole.



FIGS. 1, 2 AND 3.

As stated in the previous article, the discharge seems to be composed of two portions, one a fine blue line, and the other a red line, more hazy in its nature. When the discharge is very weak, scarcely able to jump the gap, the red line disappears. As the discharge strengthens and more current passes, the red line appears twisted in among the blue lines and jumping completely across the gap. As the current continues to be strengthened, the spark as a whole becomes more stationary. The red line, however, undergoes a peculiar change. It flattens out, becomes less distinct, and stops short before it reaches the negative terminal. In short, it forms a kind of red mist surrounding the fine blue line of discharge, as shown in Fig. 2.

Covering the spark with a thin plate of glass has a marked effect. The blue portion of the discharge almost entirely disappears, while the red portion shines with increased brilliancy, and stops short before it reaches the negative terminal as before. The red portion of the discharge is also much more sharply outlined and less like a mist or glow. Fig. 3 shows the spark of Fig. 2 covered. The difference of the two is not nearly so apparent as in the object itself. The bright white centre of Fig. 2 is bright blue, while the surrounding haze is red. In Fig. 3 the entire discharge is red, except for a fine blue line in its centre running clear across the gap, and the purple light of the negative terminal.

In order to investigate the nature of this red discharge further, a minute strip of tin foil was laid between the two terminals, as shown in Fig. 4. When the discharge was feeble, the strip received current on its left side and delivered it on its right, as would naturally be supposed. The red line appeared and could not be distinguished from the blue, except by its color. See Fig. 5. As the current was strengthened, the red took on its customary form of a hazy glow, interrupted just before it reached the negative terminals in each of the two discharges. If, however, the current was still further strengthened, the red glow shot completely over the conducting strip and stopped short before the farther negative terminal. The strip of tin foil being a negative terminal on the left side was largely bathed in purple light, but the red discharge was clearly defined against the purple background. Fig. 6 is somewhat imperfect, due to the fact that the red portion of the discharge was in rapid motion, and the gap between it and the negative terminal, which can be plainly seen in the spark itself, does not show in the photograph.

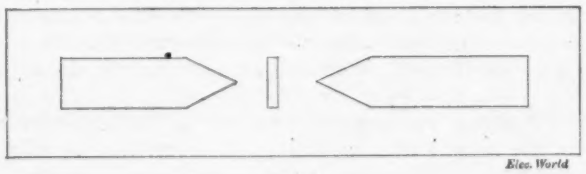
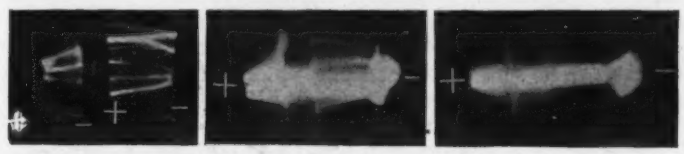


FIG. 4.

By covering the discharge with a thin piece of glass, it was much steadied, and the red glow much more sharply defined. The gap between the red glow and negative terminal can now be distinctly seen. See Fig. 7. The blue portion of the discharge seems to be the essential portion, for it is the first to show when the discharge is within striking distance.

To briefly recapitulate. As the discharge increases in strength, the blue line seems to spread out over the negative terminal as if it were a blow-pipe flame, and the red line appears. The red line as the current increases seems to exactly reverse the action of the blue. Instead of spreading out all over the negative terminal, it stops short before it gets there. It also has this property of preferring to cross over a conductor, while its blue mate utilizes it as a path. Further than this, it is enlarged and made more definite by being confined, while the blue line is weakened by this treatment. A faint and broader band of light green forms a background for this type of discharge. The edges of this band parallel to the spark are remarkably well defined, but it is too faint to show in the photograph.



FIGS. 5, 6 AND 7.

The introduction of a variable capacity in the circuit has the effect of strengthening the blue line and turning it whiter as the capacity increases. A continued increase of capacity causes the red haze to turn to a yellow, which completely envelops both ends and sides of the discharge and lacks the node so noticeable in other discharges. The blue line seems to be the essential portion of the discharge through which the current flows. The colored haze surrounding the spark may be due to either vibration, provoked by the rapid oscillation of the discharge. The fact that the haze changes color when the capacity, and hence the frequency of oscillation is changed, seems to clinch this theory. It remains to be said that the yellow light emitted by the spark whose current has the greater capacity, has a shorter wave length and hence a greater frequency of vibration than the red light of the spark, the capacity of whose circuit is less. This is directly against Maxwell's formula, which states that increased capacity means slower vibration.

A card pierced by the electrostatic discharge from a coil without the insertion of a capacity in multiple, shows a much greater blackening around the edge, and is larger than the hole made by the oscillatory discharge of the Leyden jar. The simple direct discharge seems to burn a hole, while the oscillatory discharge punches one. The appearance of the card is the same on both sides in either case. The oscillatory discharge leaves a burr. The simple direct discharge does not.

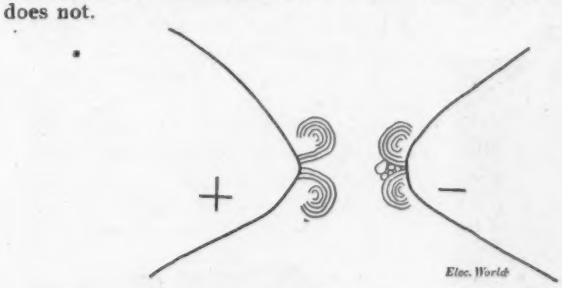


FIG. 8.

The action of the discharge on liquid shellac was accidentally noticed by the writer on a pair of covered terminals which had been flooded with this substance which was used as an adhesive. The appearance of shellac under the microscope reminds one of blood corpuscles. The action of these corpuscles around the terminals of the direct discharge is somewhat peculiar.

Starting from the centre of what is apparently the point of discharge, they proceed outward and return in a circle, their paths being very similar to the lines drawn on the terminals of Fig. 8. The negative terminal emits bubbles which enlarge and finally spring across the gap, leaving a clear space through which a blue line of discharge takes place.

One of the objects of this research has been to investigate the subject of direction of flow. Some new polar phenomena are all that have been found, and the fact that these disappear when capacity is introduced and the discharge becomes, as our theorems say, oscillatory, confirms the supposition that there is a flow of

something from positive to negative, or vice versa. This may be a wave of molecular or ether vibration, and is probably something of that nature. The fact that polar phenomena exist and reverse with our reversing switches says as plainly as nature can say it, that the flow is there, and the writer believes that an earnest study of these polar phenomena will result in a complete solution of the problem. If electricity is a wave or vibration, is it longitudinal, transverse or torsional? What is its frequency, and is that always the same, and most important of all, in what direction is the impulse propagated?

Electrodynamic Machinery.—XXXVI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

228. In all commercial circuits electro-receptive devices require to be operated either at constant current or at constant pressure. The majority of such devices are designed for constant pressure; such, for example, are parallel or multiple connected incandescent lamps and motors. Some devices, however, require to be operated by a constant current; and of these the arc lamp is the most important example. Series connected incandescent lamps and a few forms of motors also belong to this class.

229. In order to maintain a constant pressure at the terminals of a motor with a varying load, it is necessary in order to compensate for the drop of pressure in supply conductors that the pressure at

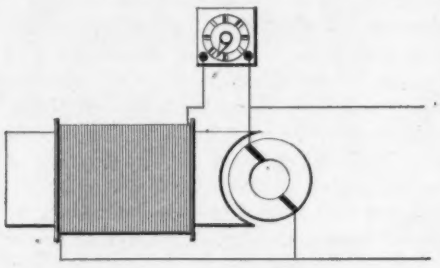


FIG. 163.—SHUNT FIELD AND RHEOSTAT.

the generator terminals either be kept constant or be slightly raised as the load increases. With shunt wound machines this regulation requires to be carried out by hand, a rheostat being inserted between the field and the armature as shown in Fig. 163.

230. Various forms are given to rheostats for such purposes. They consist, however, essentially of coils of wire, usually iron wire, so arranged as to expose a sufficiently large surface to the surrounding air as to enable them to keep within safe limits of temperature under all conditions of use. The resistance is divided into a number of separate coils and the terminals of these are connected to brass plates usually arranged in circles, upon an external surface of a plate of slate, wood or other non-conducting material, so that by the aid of a handle, a contact strip can be brought into connection with any one of them. The coils being arranged in series, the movement of the handle in one direction adds resistance to the field circuit and in the other direction cuts resistance out of the circuit. Figs. 164 and 165 show different forms of field rheo-

FIGS. 164 AND 165.—FORMS OF FIELD RHEOSTAT.

stats, with wheel controlling handles. In some rheostats the resistance wire is embedded in an enamel, which is caused to adhere to a plate of cast iron. This gives a very compact form of resistance, for the intimate contact of the wire with the iron plate, together with the large free surface of the plate, enables the heat to be readily dissipated and prevents any great elevation of temperature from being attained. Two of such rheostats are shown in Fig. 166.

231. Compound-wound machines can be made to regulate automatically, and do not require the use of a field rheostat. For this

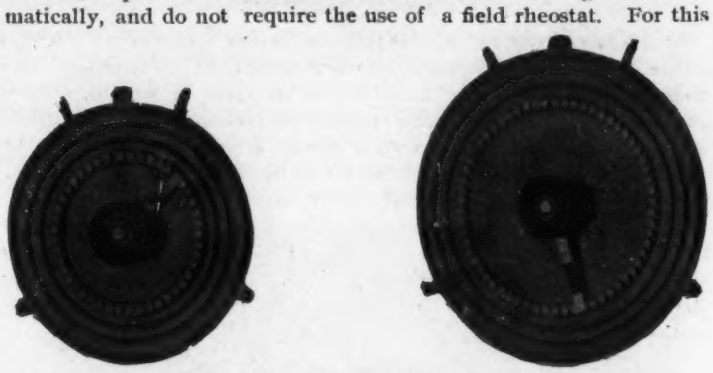


FIG. 166.—ENAMEL RHEOSTATS.

reason they are very extensively used in the operation of electric motors.

Series wound machines are invariably used for operating arc lamps in series, and, since the load which they have to maintain is apt to be variable, such machines must possess the power of varying their E. M. F. within wide limits. Two methods are in use for maintaining constant the strength of current. The method in most general use is to shift the position of the collecting brushes on the commutator so as to take off a higher or a lower E. M. F. according as the load in the external circuit increases or decreases. The effect of this will be evident from an inspection of Fig. 152, for, if the diameter of commutation be shifted to the right or left, the E. M. F. in some of the coils will be opposed to that in the remainder, the difference only being delivered at the brushes. In practice the diameter of commutation would never reach the position of maximum E. M. F. represented in Fig. 152, and might, on the other hand, rotate through a sufficiently large angle to produce only a small fraction of the total E. M. F.

232. In all cases where the brushes are shifted through a considerable range over the commutator, care has to be taken to avoid the sparking that is likely to ensue if a certain balance is not maintained between the M. M. F. of the armature and the magnetic intensity in the air gap. The fact that the current strength through the armature coils is practically constant at all loads enables this balance to be effectually maintained, when once it has been reached at any load.

233. Series wound arc light generators have their armatures wound in two ways; namely, closed coil armatures and open coil armatures. In the former, all the armature coils are constantly in the circuit, while in the latter, some of the coils are cut out of the circuit by the commutator, during a portion of the revolution. The ordinary continuous current generator for producing constant pressure is, therefore, a closed coil armature. Fig. 167 represents diagrammatically a form of open coil armature winding. The three coils shown are connected to a common or neutral point, *o*, and in the position represented the coil *A* is disconnected from the circuits, the coils *B* and *C* remaining in the circuit of the brushes *b b'*.

234. In closed coils, series wound, arc light generators, the brushes are given a forward lead; *i.e.*, a lead in the direction of the rotation of the armature, and the amount of this lead controls

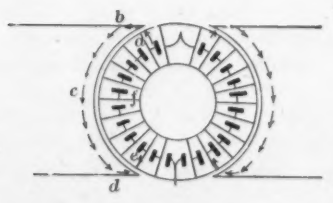


FIG. 152.—ELECTROMOTIVE FORCES IN A RING ARMATURE.

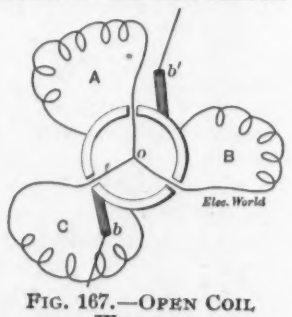


FIG. 167.—OPEN COIL WINDING.

the E. M. F. produced between the brushes. It is essential, in order to prevent violent sparking, that the coil under commutation should be running through an intensity sufficient to nearly reverse the current in the commuted coil during the time of its short circuiting. Since the current strength in the field, and also in the

armature, is maintained constant at all loads, it is necessary that the intensity of flux, through which the commuted coils run, should be uniform, or nearly uniform at all loads, and of the proper degree to effect current reversal. The M. M. F. of the field magnet is constant and the M. M. F. of the armature is also constant, but the flux produced by the M. M. F. of the armature varies with the position of the brushes and the number of active turns in the armature, covered by the pole piece, on each side of the diameter of commutation. The pole pieces are usually so shaped that as the number of active turns in the armature covered by each pole increases; *i. e.*, as the load and E. M. F. of the machine increases, the trailing pole corners become more nearly saturated and by their increasing reluctance check the tendency to increase the flux from the armature, so that an approximate balance between the field flux and the armature flux is maintained at all loads. The armature flux always opposes the field flux at the diameter of commutation, and the magnetic circuit has to be so designed that the armature flux shall never quite neutralize the field flux at this point, but shall always leave a small residual field flux for the purpose of obtaining sparkless commutation.

235. The other method, which is employed for maintaining the current strength constant, introduces a variable shunt around the terminals of the field coil, in such a manner that when the current through the circuit becomes excessive, the shunt is lowered in resistance and diverts a sufficiently large amount of current from the field magnets to lower their M. M. F. to the required value. In order, however, to avoid the necessity for making this regulation by hand, it may be effected automatically as follows: namely, an electromagnet, situated in the main circuit, is caused by the attraction of its armature, on an increase in the main current strength, to bring pressure upon a pile of carbon discs. This pile of discs offers a certain resistance to the passage of a current, the resistance of the pile diminishing as the pressure upon it increases. The pile is placed as a shunt around the field magnet, so as to divert from the magnet a portion of the main current strength. When the pressure from the armature of the electromagnet increases the pressure on the pile, the resistance of the shunt path is diminished, and less current flows through the field magnets, as represented in Fig. 168,

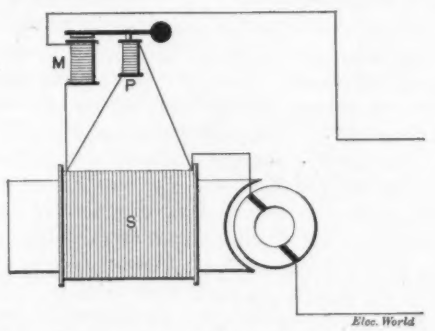


FIG. 168.—DIAGRAM OF AUTOMATIC REGULATOR CONNECTIONS.

where *S* is the series winding, shunted by the carbon pile *P*, and *M* is the controlling magnet inserted in the main circuit.

236. Both the above methods are capable of compensating not only for variations in the resistance or C. E. M. F. of the circuit, but also for variations in the speed of the driving. In this respect the compensation is more complete than that of constant pressure machines; for compound wound generators can maintain a constant pressure under variations of load, but not under variations of speed.

237. When a system of electric conductors is supplied from a central station, it is evident, that if the load on the system was constant, a single large generator unit would be the simplest and cheapest source of electric supply, except, perhaps, on the score of reserve, in case of accidental breakdown. In practice, however, the load is never constant, and, therefore, the generating unit is always considerably less than the total activity that has to be supplied at the busiest time. Moreover, engines and generators are necessarily so constructed, that while they may be comparatively very efficient when working at full load, they are far less efficient when working at a small fraction of their load, so that it is desirable to maintain such units as are in use at full load under all circumstances. This consideration of wasted power, in operating large units at light loads, applies with less force to plants operated by water power, but even in this case it is usually found uneconomical to operate a large generator, for many hours of a day, when a smaller one would be quite competent to supply the load.

238. The generating units in a central station are, therefore, so arranged that they may be individually called upon at any time to add their activity to the output of the station. Electrically these generators must be connected either to separate circuits, in series or in parallel.

The first method, so far as continuous current circuits are concerned, is only employed for arc lamps operated in series. When a large number of arc lamps have to be supplied over a given district, they are usually arranged in different circuits, each circuit containing approximately the same number of lamps; each such circuit is then connected, as full load, to a single arc-light generator. When, however, some of these lamps are cut off, so that the load on individual arc generators is considerably reduced, two or more of these underloaded circuits may be connected in series, at a specially designed switchboard, and supplied by a single generator.

239. Generators are connected in series when it is desired to employ on the external circuits the sum of the pressures of those generators. For example, in cases of the transmission of power to considerable distances a high pressure in the conducting circuit is economically necessary. Whenever this pressure is greater than that which can be readily obtained from a single continuous current generator it is possible to connect two or more generators in series, so as to obtain the sum of their pressures. Thus, five generators, each supplying 500 volts pressure, will, when connected in series, supply a total pressure of 2,500 volts.

240. As a modification of the above plan, which is rarely adopted, five-wire and three-wire systems, employing respectively four and two generators in series, are in use. The five-wire system, although employed in Europe, has not found favor in this country. The three-wire system, however, is extensively employed. In this system, two generators of equal voltage, say 125 volts, are connected in series so as to supply a total pressure of 250 volts. Such a pressure is capable of operating incandescent lamps in series of two. To enable single lamps, however, to be operated independently, a third or neutral wire is carried through the system from the connection point of the two generators, and the distribution of lamps, on the two sides of the system, is so arranged that the equalizing current, passing through the neutral wire, is small, and nearly as many lamps are operated at any one time on the positive, as on the negative side of the system. A pair of generators connected for three-wire service, therefore, constitutes a generating unit in a central station.

241. It occasionally happens in the case of series arc circuits that owing to some accident that may occur to a line wire, it becomes necessary to connect two lines together, so as to form an extended loop, in order to maintain the supply of the disabled line. This often requires that not only two lines but also the two generators for those lines be connected in series.

242. Series generators are never, in practice, connected in parallel. Shunt wound and compound wound machines are capable of being connected in parallel, and most central stations arrange the generators in such a manner that they may be connected to or disconnected from the mains according to the requirements of the load.

243. Central stations, supplying incandescent lamps in parallel, usually employ shunt wound generators, for the reason that the efficient and economic operation of the lamps require a uniform pressure at all lamp terminals.

Not only does the uniformity in the amount of illumination from an incandescent lamp depend upon the uniformity of the pressure supplied at its terminals, very small variations in the pressure markedly varying the intensity of illumination, but also such variations of pressure materially affect the life of the lamp. Thus a 50-watt, 16 cp, incandescent lamp, intended to be operated at a pressure of 115 volts, would have its probable life reduced by 17 per cent., if operated steadily at 116 volts, and reduced by about 33 per cent., if operated steadily at 117 volts pressure. For this reason the pressure in the street mains supplying the lamps requires constant careful attention. Since it would be impossible to obtain at the mains a sufficient uniformity of pressure, under all conditions of load, by compound winding, and hand regulation would still be required, there is an advantage in dispensing altogether with compound winding, and resorting to hand regulation, with shunt winding, for the entire adjustment.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

Rope Driving.—XVII.

BY J. J. FLATHER.

An abnormal degree of slack side tension has a direct effect upon the wedging of the rope in the groove, for if sufficient sag is not allowed, and the slack side tension is therefore needlessly great, it follows that the power transmitted will be reduced, since the driving force P is equal to the difference of the tensions in the two portions of the rope $= T_1 - T_2$; on the other hand, the force drawing the rope into the groove will be increased, since this force equals

$$T_1 - F_0 + T_2 - F_0{}^2 = P + T_2 + T_2 = P = 2\,T_2.*$$

It is obvious, therefore, that the slack side tension should be no greater than just sufficient to give adhesion to the ropes and prevent undue slip at the desired speed.

As to the best angle for the groove in the pulley, opinion is still somewhat divided, but in England the general practice seems to favor an angle of 45° as the most suitable.†

In the earlier installations a more acute angle was used, as evidenced by the discussion of Mr. Durie's paper on "Rope Driving" presented to the British Institute of Mechanical Engineers.‡ Grooves having an angle of 30° had been tried, but it was found that the wear on the rope was altogether too great; 40° was a very satisfactory angle, and is still preferred by many engineers, while others use as large an angle as 60°. Occasionally half round grooves are used, but with semi-circular grooves on cast iron pulleys either the tension in the rope must be increased or a greater number of ropes must be employed; in any case the advantage seems doubtful. With wooden rimmed pulleys, however, the semi-circular groove is the better

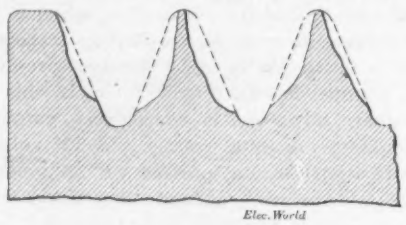


FIG. 44.

form, for since the coefficient of friction on the wooden pulley is from 30 to 50 per cent. greater than for a similarly shaped groove on an iron pulley, it follows that the tension in the rope need not be great; moreover, wooden pulleys that have been in use several months would indicate that the semi-circular groove is better adapted to the work, as, with anything but very light loads, the angular groove is soon cut out by the rope, producing a rim somewhat similar to the one shown in Fig. 44, which represents an angular grooved wooden pulley that had been in use but a few months.

With a semi-circular groove in the first place, the pulley will retain more nearly its original form, and the wear on the rope will be greatly reduced.

The pliability of the rope has considerable influence on the shape of the groove; while a 30° angle may give the correct shape for a soft, loosely twisted cotton rope, a harder twist may require an angle of 40° or even 50°; in the same way a 40° groove may be all right for some makes of manilla rope, while others of a less yielding nature would give better results if an angle of 50°, over even 60° were used.

At the present time there are very few pulleys used in this country, except for machine bands, having grooves with an angle less than 40°. Formerly the Yale & Towne Manufacturing Company employed grooves of 30° for small cotton ropes (about ¾ inch in diameter), driving their traveling cranes, but these subsequently were changed to 50°, and at the same time larger ropes, 1¼ inch, were adopted. For manilla rope drives one large manufacturer uses an angle of 60° on all his pulleys; this angle was arrived at after much trial, and represents an experience with manilla rope transmission covering a great many years. The most suitable angle of groove is that which affords the greatest frictional adhesion without undue slip, and at the same time offers the least resistance to the rope in leaving the groove; with much slip the rope is rapidly worn out, while with an excessive grip the wear is also rapid and a relatively large amount of force is absorbed in overcoming the wedging.

* Although the centrifugal force increases the tension in the rope its tendency is to cause the latter to leave the pulley, and therefore should be deducted in this case.

† "M. E." in *American Machinist*, Nov. 10, 1892.

‡ See Proc. Inst. M. E., 1876.

The usual practice in this country for both cotton and manilla ropes is an angle of 45°; in many cases the section of the groove is formed by arcs of circles having a radius equal to from 3 to 4 diameters of rope, in which case the included angle is constantly changing, and the coefficient of friction, and hence the grip, will vary with the diameter of rope used. Thus, in Fig. 45, if A, B, and

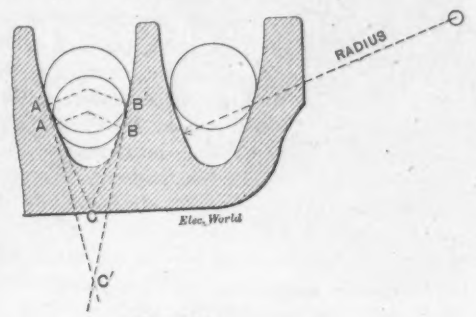


FIG. 45.

A', B' represent two ropes of slightly different diameters running over a grooved pulley, the one which sinks deeper into the groove will include the greater angle of contact A, B, C, and hence the lesser coefficient of friction; this will hold true of two ropes having the same diameter b it different degrees of twist; the harder rope will not sink as deeply into the groove, and its coefficient of friction will be greater than that of the smaller rope—other things being equal—on account of the lesser angle in the groove.

With the excellent ropes that are now being made for transmission purposes, this form of groove possesses many advantages, even with the continuous wound system. In this system the tension is assumed to be the same in each wrap, but there is unquestionably a variation of pull due to momentary fluctuations which must either be absorbed by the elasticity of the rope or transmitted through the rope until the strains are equalized. If the rope used is uniform in structure that portion which receives the greater strain will be drawn more deeply into the groove, and if the latter be of the curved form, the coefficient of friction will be reduced so that the resultant adhesion produced in this portion of the rope will be less than that in some other part, which, under a lighter strain, occupies a position on the pulley such that its coefficient of friction and consequent adhesion is greater, for a given back tension.

With the usual arrangement of pulleys, namely, that in which the larger wheel is the driver, the tendency of an increase in tension is to increase the velocity of the driven pulley. If several wraps of a series occupy positions in the grooves such that with a given ratio of pulley diameters the velocity of the smaller pulley is twice that of the driver, any decrement, x, of the effective radii of another wrap which is drawn more deeply into the grooves of the two pulleys will alter the velocity ratio from $\frac{2}{1}$ to $\frac{2-x}{1-x}$, a quantity which must of necessity be greater than 2. The tendency of this wrap, then, is to produce a greater velocity in the driven pulley, which cannot occur without some slip in the other wraps; but these wraps have a greater adhesion, and, therefore, tend to drive the pulley at a less number of turns per minute which will produce slip in the more heavily strained member; hence the effect of any change in position due to sudden increased strain on one wrap will tend to quickly adjust the tensions in all portions of the rope, and neutralize any inequalities in driving effort. This form of groove, as we shall show subsequently, is even more desirable for the individual rope system where the evils of differential driving are frequently so pronounced.

As noted in a previous paper, the frictional grip depends both upon the arc of contact of the rope with the pulley and the coefficient of friction, which latter varies with the angle of the groove. In order, therefore, to produce the same friction on each pulley the product of the arcs of contact by their respective coefficients of friction must be equal. If, as before, we take the coefficient of friction of a lubricated rope on a smooth, flat metal pulley equal to 0.12, the coefficient for the same rope in a groove whose angle is θ degrees will be $\phi = 0.12 \operatorname{cosec} \frac{\theta}{2}$; hence with arcs of contact a and a' we should have for an equal grip on each pulley

$$\Phi a = \Phi' a' \text{ or}$$

$$0.12 \operatorname{cosec} \frac{\theta}{2} \times a = 0.12 \operatorname{cosec} \frac{\theta'}{2} \times a',$$

assuming that the multiplier 0.12 will give the correct coefficient of friction on each pulley, since the percentage of slip is to be the same. As the numerical value of the cosecant of an angle varies inversely with the angle, it will be obvious that the pulley having the lesser arc of contact should also have the more acute angle in the groove; this property of rope friction is frequently taken advantage of in designing a plant, and it is not uncommon to find the grooves in the large wheel more obtuse than those in the smaller—especially when there is considerable difference in the diameters of the pulley.*

From the above equation there is obtained

$$\text{cosec}\,\frac{\theta}{2} = \text{cosec}\,\frac{\theta'}{2} \times \frac{a'}{a}$$

in which θ and a represent the angle of groove and arc of contact, respectively, on the larger pulley; and θ' and a', similar values for the smaller pulley. With the least angle of groove equal to 35°, 40°, or 45°, the corresponding angle in the larger pulley should be as indicated in Table XVI., when the ratio of the arcs of contact is known.

TABLE XVI.

ANGLE OF GROOVE FOR EQUAL ADHESION.

Arc of contact on small pulley / Arc of contact on large pulley $= \frac{a'}{a}$	0.9	0.8	0.75	0.7	0.65	0.6
Angle of groove in large pulley when groove in small pulley = 35°.....	40°	44°	47°	51°	55°	60°
Angle of groove in large pulley when groove in small pulley = 40°.....	45°	50°	54°	58°	64°	70°
Angle of grove in large pulley when groove in small pulley = 45°.....	50°	55°	60°	66°	72°	80°

Of course, an idler or binder pulley may be used to increase the arc of contact on the smaller pulley, and thus maintain an equality of grip on each pulley; but this device produces an objectionable reverse bend in the rope which should be avoided as much as possible in rope transmission. Both of these arrangements, as well as the winder pulley, previously discussed,† are intended to prevent slip, and at the same time obtain the maximum adhesion for the least amount of back tension, without increasing the losses due to wedging in the grooves, journal friction, and wear in the rope.

As pointed out by Mr. W. H. Booth,‡ although there may be some loss and wear due to wedging in the grooves, by far the greater loss is occasioned by the deeper wedging of one rope as compared with another, so causing them to grip upon a different circumference, in which case each rope tends to impart a different velocity to the driven pulley; the actual resultant velocity will be a mean of the several velocities of the individual ropes, so that slipping and wear of some or all of the ropes must occur, due to the differential driving thus set up.

With the continuous rope transmission this effect is not so apparent, although it exists to a certain extent on account of inequalities in the rope and various mechanical imperfections in the system; but in the English or independent rope transmission its effect is very marked, and is generally considered as the principal source of loss of efficiency in this system.§

While there is undoubtedly a considerable loss which may be charged to this cause, it is also true that its effect may be greatly reduced by a careful study of the requirements of the problem, and an intelligent application of correct principles to the case in hand.

(To be continued.)

Definition of Polyphased Systems.

To the Editor of The Electrical World:

SIR:—To me the definition of a polpyhased system is very simple: "poly" means several, consequently a polyphased system is, in the words of Prof. Hospitalier, the creator of the term, "a system comprising the employment of several alternating currents of different phase."

I do not see why, for the sole sake of pleasing Mr. Steinmetz, we should modify a definition so clear and one so universally admitted during the last four years. Mr. Steinmetz himself—coming from whom the new definition is still more to be criticised—would doubtless never have thought of advocating the change if the accepted definition did not have for him an entirely special inconvenience—that of causing the monocyclic system to fall into a known category.

The monocyclic system is, in fact, nothing else than a *polyphased system* by means of which two phases are transformed (for what reason we do not know, unless it is to avoid the patents of another company), into three phases or into one, according to whether the motors are starting up or working under load. To wish to modify the definition of polyphased currents in order to avoid this conclusion is evidently a radical proceeding, and one which will not be countenanced by those having no ulterior interest in the matter. By applying the same method of reasoning, we can, in fact, just as well show that a dog which can momentarily support himself on his hind legs is not a quadruped. If I may be permitted to make a trivial comparison, the monocyclic system may be defined as a two-phased animal which dispenses with one of its phases when the motors are running under load.

It is, without doubt, from the considerations referred to that Mr. Steinmetz rejects the word polyphase; the ordinary public, however, which calls a spade a spade, is, unfortunately, not apt to lend its attention to such subtleties, and will not be pleased by having its supposed credulity thus imposed upon.

As to the system which has been the subject of this curious discussion, it is certainly very ingenious, as is everything which comes from the same capable source. I confess, however, not having been able, any more than Mr. Scott, to see its advantage over a properly designed two-phased system, while I do see very well that it is inferior to such a system, both in the power and efficiency of its machinery. One may assign it the finest name in the world, and change all known definitions—this will avail nothing.

PARIS, FRANCE. A. BLONDEL.

Electrical Cats.

To the Editor of The Electrical World:

SIR:—The explanation suggested by Mr. Balcom, in your issue of May 11, 1895, to account for his getting a spark on releasing a cat from his grasp, as stated by him in the words "I am of the opinion that the cat may possess on a small scale an organ, etc.," is much further from the truth than the explanation the child gave for certain other feline peculiarities, which was that she had "tacks in her feet." The fact that a cat when dry will, as a whole, become electrified by stroking or handling *ought to be familiar enough.* The charge remains "bound" and of low potential until the release or removal of the outer conductor (the arms of the person holding it) when with a great increase of potential, due to diminished capacity of Mr. or Mrs. Cat, a spark strikes through the fur just as the release is effected. This is all well known as applying to every cat without any special electrical organ or gymnotic affinities.

If Mr. Balcom will study the cat as an example of that old and most instructive instrument, the electrophorous, neither he nor the Professor of the Buffalo Electrical Engineering School would need to call upon you to disseminate his facts. I sometimes think it would be useful for any observers of electrical phenomena to take a course of reading of the books extant in the latter part of the century 1700-1800, when cats and other familiar things formed an important class of electrical apparatus submitted to experiment.

LYNN, MASS. ELIHU THOMSON.

To the Editor of The Electrical World:

SIR:—I notice in your issue of May 11 a letter suggesting that the cat may possess an electrical organ similar to the electric torpedo. I am always interested in anything of this kind, and as I am the possessor of nine pet cats, and have made a great many electrical experiments, I beg to differ with Mr. Balcom's theory in regard to any organ or muscles of an electrical nature in connection with a cat. I think when you come to investigate closely you will find that the shock experienced is caused simply by the friction of the cat's fur. I have experienced quite strong shocks from my cats, but, of course, obtained the best results in cold, dry weather. However, I should be pleased if any of the readers of THE ELECTRICAL WORLD have any additional information on the subject, and in case it is found that the cat is capable of producing electricity we might connect up a few of the felines in series and utilize the current for gas lighting, etc. CHAS. E. HERRIMAN.

GIRARD, KAN.

* Mr. T. Spencer Miller, of the Lidgerwood Manufacturing Company, has been granted a patent upon the application of this principle to continuous rope transmissions in which with sheaves of different diameters more obtuse grooves are used in the larger wheel.

† ELEC. WORLD, Dec. 23, 1893.

‡ *American Machinist*, Dec. 8, 1888.

§ See *American Machinist*, Dec. 1, 1892.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Pre-Determination of the Loss of Voltage in Transformers.—A brief paper on this subject by Mr. Kapp is reprinted in full in the "Elec. Zeit.," April 25. He calls attention to the difficulties in determining the loss of voltage by direct measurement, especially with large transformers, as a large amount of power and a resistance which will absorb it, are necessary, the phase shifting in the secondary circuit must be known, and even then the result will be correct only for that phase difference. He describes the following method which makes it possible to predetermine the voltage for all loads and phase differences, the method being based on a very simple experiment requiring very little power and no resistance. The principle of the method is as follows: in

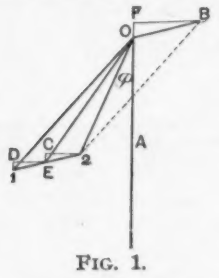


FIG. 1.

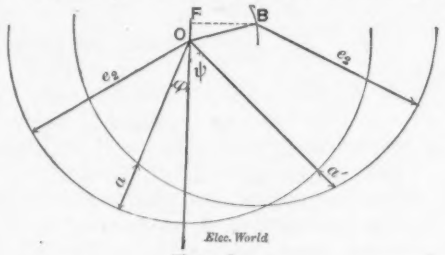


FIG. 2.

the adjoining Fig. 1 let $O\,A$ represent the vector of the current in the secondary coil, $O\,2$ the vector of the secondary voltage at the terminals and ϕ the phase difference produced by the induction in the external circuit; if the external circuit had a capacity instead, this angle would be negative and would lie to the right of that line. The E. M. F. induced in the secondary must contain three components, first $O\,2$, secondly a component representing the ohmic loss of voltage, which is in the same direction as $O\,A$, and thirdly, a component which balances the self-induction in the secondary coil and which in the diagram would be represented by a horizontal line to the left; let $C\,E$ and $2\,C$ represent the two latter, then $O\,E$ is the vector of the induced E. M. F. The same construction could be applied to the primary coil starting from $O\,E$, but in order not to increase this in the transformer ratio, it can be supposed that the primary is divided into groups of m parallel wires; the primary voltage would then be reduced to $1 \div m$, the primary current increased m times and the resistance diminished $1 \div m^2$ times; the vector $O\,E$ will then give the induced E. M. F. in the secondary as well as in the primary; the primary voltage is then divided into three components like the secondary; in modern transformers with closed magnetic circuits the vector of the primary current is almost exactly in the continuation of that of the secondary current, as the ampere windings required for magnetization are negligibly small as compared with the others; this vector can therefore be assumed to be vertical as also that corresponding to the ohmic resistance, while that due to self-induction is horizontal; let the latter be $E\,D$ and the former $D\,1$; this gives $O\,1$ as the vector of the primary voltage at the terminals; the relative position of the points 2 and 1 depends only on the secondary current, the resistance of the coils and the E. M. Fs. generated in the coils, but not on the phase difference or the terminal voltage in the external circuit; the distance 1 2 is directly proportional to the current, while the inclination depends upon the resistance and the inductance; if $O\,B$ is made equal and parallel to 1 2 then $B\,2$ is the primary terminal voltage and $O\,2$ the secondary, for that current for which $O\,B$ represents the E. M. F. for the resistance and the inductance. This E. M. F. can be easily determined by the following method: the secondary terminals are short-circuited through an ampere meter and a sufficient voltage, at the proper frequency, is applied to the primary to produce the normal current in the secondary, the amount of energy required being extremely small; if the primary voltage, as obtained, be divided by m it will give the length $O\,B$. To determine the inclination of $O\,B$, calculate the loss of voltage due to the ohmic resistance and lay it off as $O\,F$, then $F\,B$ is the E. M. F. of self-induction, at the observed current. As $O\,B$ is proportional to the current, then for no load B and C coincide, likewise 1 and 2; that is, the primary and secondary terminal voltage are then the same. If from O and B circles are drawn (as shown in Fig. 2) whose radii represent the secondary terminal voltage at no load, then on any vector the portion between the circles, shown at a, is the loss of voltage corresponding to the phase shifting represented by the angle of that line, be it positive or negative. For other currents the point B must be moved correspondingly, the radii of the circles remaining the same. If a liquid resistance is used in testing the transformer, then the circuit has a capacity and the direct measurement will give a loss of voltage which is too small; there can then under certain circumstances even be an increase in voltage, therefore giving quite incorrect results. The graphical construction, Fig. 2, can also be used to show the effect of the frequency; for small leakage and resistance the point B will approach F for an increasing frequency, and if the transformer is used with inductive circuits then the voltage loss will become smaller by diminishing the frequency and *vice versa;* the frequency should therefore be as small as possible. In order to define the allowable loss of voltage in ordering transformers, he suggests that the primary voltage be given which will generate the normal secondary current when the secondary is short-circuited; this is easily verified and suffices for characterizing the transformers.

In the discussion which followed Mr. Dobrowolsky spoke very highly of this method which he says is of great practical value; he has applied it and gave the results of carefully made measurements which prove the correctness of the method. Mr. Goerges also gave some experimental data; he adds that he noticed that with no load the transformer ratio does not agree with the theoretical; with high voltages the two coils in a transformer must be farther apart, and in that case he noticed an interesting phenomenon, namely, that the air space between the primary and the core contains practically no magnetism, while that between the two coils is traversed by a very strong field; in the space between the core and the coil the two magnetic fields must be subtracted while in the other space they must be added; this method was used to determine the leakage. Mr. Dobrowolsky in reply claimed that it was not necessary to separate the two coils by such a large space; he also stated that 18 to 20 sq. cm. per watt lost, provides a sufficient surface to radiate the heat. Mr. Goerges stated that his company (Siemens & Halske) has constructed transformers for 10,000 volts and for 1,500 kilowatts in which the distance between the two coils was about three-fourths of an inch.

Iron in Transformers.—The mean results obtained by Prof. Ewing, of the hysteretic losses for the iron made by a certain London firm, are published in the "Elek. Zeit.," May 2; the hysteretic loss is very small.

Transformers.—Some tabular data for the single and three-phase transformers of the General Electric Co., of Berlin, is published in the "Zeit. fuer Elek.," May 1.

Theory of the Synchronous Motor.—A paper on this subject was read by Mr. Rhodes before the Physical Society of London, a very brief abstract of which is given in the Lond. "Elec. Eng.," May 3; the object is to give as simple a treatment as possible of the mathematical part of the subject and to give theoretical proofs of some experimental facts. Prof. S. P. Thompson stated that the mathematical part was much simpler than that in previous investigations on this subject; the part of the paper relating to armature reactions and phase relationship was quite new; two results deserve special attention, first, with the maximum current at zero the power was the same as if the circuit was non-inductive; secondly, with the maximum current at zero the power was double the current corresponding to the maximum output.

Calculation and Construction of Continuous Current Dynamos.—A short lecture by Mr. Picou is reprinted in "L'Eclairage Elec.," April 20; it is devoted almost entirely to an explanation of the method of calculating a 75 kw machine for 300 amperes and 250 volts. Regarding the different types of dynamo he says that in principle there is no superiority of one over the other, but that each type is specially adapted for different purposes. He states that experience has shown that up to about 80 kilowatts it is best to use 2-pole machines and above that, multipolar.

Simple Graphical Interpretation of the Determinental Relation of Dynamos.—A Physical Society paper by Mr. Bryan is abstracted very briefly in the Lond. "Elec. Eng.," May 3; the paper appears to be mathematical in character.

Performance of the Tesla Motor.—"El'ty," May 15, publishes a number of curves of the performance of a 50-hp motor which is running at

the Westinghouse works, on the regular two-phase circuits at 220 volts, 3,000 alternations and 750 revolutions. The maximum starting torque of which the motor is capable, is a little over 2.5 times the full load running torque but this starting torque is not required in ordinary practice, as a resistance in the secondary of the motor has such a value that the starting torque is about 1.5 times the full load running torque; with this resistance the current taken by the motor at starting is about 50 per cent. more than that at full load; when running unloaded the motor takes 18 apparent horse-power; the speed falls less than 2 per cent. from no load to full load; the apparent and true efficiencies rise very rapidly as the load increases; at one quarter load the former is 57 per cent. and the latter 84 and at full load they are 81.5 and 89.5, respectively; the latter is said to be better than that ordinarily attained by direct current machines of the same output, and the light load efficiency is much better; the all-day efficiency will therefore be higher than that of a direct current motor if the power required is variable; the ease with which it can be controlled both "as to speed" and as to direction of rotation make it superior to the ordinary motor.

LIGHTS AND LIGHTING.

Tests of Incandescent Lamps.—A long Physical Society paper by Prof. Ayrton and Mr. Medley on "Tests of Glow Lamps and a Description of the Measuring Instruments Employed" is published in full with numerous illustrations and curves in the "Phil. Mag." for May; a reprint of the paper is begun in the Lond. "Elec. Rev.," May 3; an abstract of this paper appeared in the Digest, Feb. 23. The authors begin with a discussion and comparison of previously published papers on this subject including those of Ayrton and Perry, Fleming, Howell, Feldmann, Thomas and Hauptman; in the light of the knowledge obtained from the experiments described in those papers the formula in the first of these papers requires to be changed and must now be written: cost per hour per candle equals the product of the price of one watt-hour and the average watts per candle, added to the quotient of the price of a lamp divided by the total candle-hours. From the experiments of Prof. Thomas (in America) he deduces curves, the ordinates of which are the total costs per hour per candle and the abscissas are the life in hours, which curves, as is well known, show a minimum point sometimes termed the "smashing point"; that is, the point at which it would seem to be economical to discard the lamp. The present tests, which were begun at the end of 1892, were made with Edison-Swan lamps (English) of 100 volts and 8 cp, and were intended to find out experimentally what was the most economical voltage and the length of their economic lives for different prices of the energy. The apparatus, which appears to have been quite elaborate, is described in detail with the aid of some illustrations; the lamps were run from storage batteries so arranged with an adjustable resistance in circuit and an automatic regulator, that the voltage did not vary as much as one-tenth of a per cent. and if a lamp broke the exact time of breaking was indicated automatically; a 2-cp Methven screen with pentane gas was used as a standard in connection with a 10-cp low voltage incandescent lamp; the latter was mounted so as to gently swing backward and forward in the direction of the bench, the effect thus produced being found to be an improvement on that usually obtained by moving the photometer screen first a little to one side and then to the other. The photometric measurements did not differ from the other more than 0.3 per cent. It was noticed that after starting the tests, the candle-power, current and the candles per watt, all rose as the lives of the lamps increased; a number of tests were made to satisfy them that this unexpected result was correct; curves showing the results of the tests are given for four groups of lamps run at 100, 101, 102 and 104 volts, respectively, both the candle-power and the current being indicated; the lamps which were tested showed hardly any blackening, even when the filaments lasted for over 1,300 hours. Although the rise of candle-power was always accompanied by a rise of current, yet the former was proportionally much greater than the latter and the consumption of power per candle was therefore less after the lamp had run for 50 hours than it was at the beginning, and the power per candle did not rise seriously during the whole life of the lamp. The following is a summary of the results: for the first 500 hours and for the 100-volt lamps the consumption was 4.0 watts per candle; for the second 500 hours it was 4.36 watts and for the third 4.55 watts per candle, the average for the whole being 4.35; for the 101-volt lamps the candle power rose 15.5 per cent. in the first 150 hours and the current rose 4.72 per cent., the watts per candle falling from 4.80 to 4.32 with an average of 4.68; for the 102-volt lamps the rise in candle-power in 120 hours was 14.4 per cent., the watts per candle diminishing from 4.22 to 3.82, the average consumption of energy during the first 500 hours being 3.9 watts per candle, during the second 4.06, and during the third 4.2, with an average for the whole of 4.12; with the 104-volt lamps the breakages were very frequent, the initial rise in candle-power was 19.8 per cent. and the average watts per candle were 3.6. They found that when first started the light varied approximately as the seventh power of the voltage when the latter is something like the normal; but after they have been used for 100 hours it varies about as the fourth power. Among the conclusions from their tests it was stated that when a group of these lamps is run at 100 volts and each broken lamp is replaced by a new one it may be expected that the light given out by the group will never be as small as it was at the beginning; that such lamps, marked 8 cp, will give an average illumination at 100 volts, during their whole life, of about 10 candles and will absorb an average power of about 4.3 watts per candle; that during a large portion of their life they may give as much as 11.7 candles. They show that this rise in candle-power at the start was also shown in the curves of Feldmann, in which, however, the greatest rise was only 14 per cent. while they had noticed 45 per cent., and in the former the candle-power at the end was always much less than at the beginning, while with the latter the light given out by a group of lamps was never as low as it was when the lamps were new; in their tests the power per candle not only diminished considerably during the early life, but never rose again as high as it was when the lamps were new; this remarkable rise during the earlier part of the life of these lamps has a very important effect on the economy of lighting with incandescent lamps. The next point considered is the way in which the cost of lighting with these lamps depends on the voltage; several interesting curves are worked out giving the cost per hundred candle-hours for different times in hours, replacing the broken lamps with new ones; these total cost curves show that there is nowhere any such rise in cost of producing light as was shown in similar curves for American lamps, except when the cost is 18 cts. per kilowatt-hour in which there is a slight indication of a turning up of the curve; with these lamps there is, therefore, no point to indicate that the time has been reached when it would be good economy to discard the lamps before the filaments break. Owing to the extent to which individual lamps vary among themselves, it is difficult to say which of the four voltages would be most economical to use; at nine cents per kilowatt-hour, the lamps tested at 100 volts gave the cheapest light, and at 18 cents there is not much to choose between the cost of producing light at the different voltages; they therefore conclude that no marked economy can be gained by forcing this type of lamp.

The original paper was read Dec. 14 and an addition read Jan. 25 follows the present article; in this they discuss the cause of the rise in candle-power; Mr. Howell at the American Institute of Electrical Engineers, stated that such a rise was due to the vacuum of the lamp improving, and they therefore made some experiments to test the validity of this by applying the induction coil test to new lamps and again after 80 hours, finding that in every case the vacuum has apparently improved, but the conclusion that the explanation was correct has been modified by tests made since in which they find that the improvement in the vacuum is not accompanied by the great rise in candle-power which they found in the first tests which were the subject of their paper; the apparent increase in the vacuum in a set of lamps purchased recently was produced slowly, and not suddenly on the first application of the voltage; they give the results of the test of this batch of lamps from which it appears that in some lamps there was practically no change either in the light or in the power absorbed during the first 80 hours and in the remainder the increase was comparatively small; as the vacuum appeared to improve steadily with all the lamps it was not the sole cause of the rise in the candle-power; they suggest that it may have been due to the change in the surface of the filament causing the emissivity for heat to decrease but whether such a change occurs they have not yet found out; at present they say it is impossible to give the most economical voltage, as the lamps differ too much among themselves; they conclude, however, referring to the first test, that the best voltage is that which corresponds to four watts per candle during the larger portion of its life; to calculate this they give the equation that this voltage is equal to a constant multiplied by the watts per candle raised to the minus 0.285th power.

Products of Combustion of the Electric Arc.—An Academy paper by Mr. Grehant is reprinted in "L'Elec.," May 4. He describes tests which he has made, in which the lamp was enclosed in a box and a dog was made to breathe the air surrounding the arc for half an hour, after which the blood of the animal was tested for carbon monoxide; in the first experiment it was found that the air contained one part carbon monoxide in 1,400, in the second it was one in 3,000 and in the third one in 2,500; in the second there was one part of carbonic acid gas in 57 and in the third one in 62. He concludes that it is certain that carbon monoxide is produced in the electric arc in small quantities and that in small rooms this poisonous gas is therefore formed in sufficient quantities to cause the serious diseases among workmen which have been noticed; it is therefore necessary to have sufficient ventilation.

In referring to the paper editorially the Lond. "Elec.," April 26, states that it may be regarded by some as indicating a latent danger in arc lighting, but it adds that the carbon burnt per unit of light is certainly smaller in the case of the arc light than in any other comparable method of illumination; ordinary ventilation, if sufficient for carrying off the products of combustion of the human being, will suffice for the disposal of the products of combustion of the arc lamp.

Decorative Electric Lighting.—The Lond. "Elec. Rev.," May 3, contains a long article with a very large number of half-tone illustrations of lighting effects in installations in England.

POWER AND HEAT.

Heating and Cooking.—The Lond. "Elec. Rev.," May 3, gives a brief abstract of Mr. Crompton's paper (see Digest last week) including some

deductions made from it, one of them being that the efficiency of the larger tea kettle was 63 per cent. and of the smaller one 71.5 per cent., which shows that the time taken is a very important factor in determining the heat lost and therefore the economy of the operation; the smaller one is most efficient, doing its work in two-thirds of the time. In some deductions concerning the radiators it appears that the current increased with the heat, although naturally one would suppose that it would decrease. In an editorial note it is believed that the advantages of electrical cooking to the central stations have been overrated; belief is expressed that the use of these domestic appliances will be to extend and develop the business of supplying, rather than flatten the load curve; the valley to be filled up is so deep that it would require a very general use of electricity for culinary operations to do much in this direction.

Application of Electric Power in Agricultural Operations.—The "Elek. Anz.," April 28, reprints a lecture by Mr. Brettschneider giving in detail the cost of operating the electric plant on his large estate. The power, about 18 horse-power, is generated by a neighboring waterfall; there is a battery of accumulators in connection with the plant; the list of lamps and motors is given in detail showing a total output of 34,000-hp-hours per year; the first cost and cost of operation are given, the former being $7,500 and the latter $1,500 or 4.4 cents per horse-power-hour; he could have obtained double the power at the same cost if he had had use for it, and the cost would then have been reduced one-half; he compares this with the cost of operation of the former installation in which the power was generated by steam and horses, which was $1,800, to which several other items should have been added. The objection to the installation is that he is dependent on the water supply and in winter is troubled with anchor ice.

Applications of Electric Power.—A brief description of some of the applications at the large Crewe railway works, is given in the Lond. "Elec.," May 3, including illustrations of some of the apparatus; one of them is a 20-ton Gantry crane manipulated entirely by a man on the level with the work; a locomotive boiler tube cutter is illustrated.

Mechanical Applications.—"L'Eclairage Elec.," April 20, gives in Mr. Richard's long serial a well-illustrated description of the telemotors of Mr. Williamson for operating the rudder of a vessel from a distance. He also describes other applications of electric motors operated from a distance.

Belt and Rope Transmission Tests.—An article from the French by Mr. Dubreuil is translated in abstract in the Lond. "Elec.," May 3; it gives results of tests in which the power was measured; in the conclusion it is stated that ropes and belts when well fitted absorb practically the same amount of power. In the leading editorial the tests are commented on unfavorably.

Refuse Destructor.—Lond. "Lightning," April 25, contains an illustrated article by Mr. Brookman describing the Rochdale Corporation Manure Works; high pressure steam is raised by means of fuel consisting of unscreened refuse unmixed with coal; the temperature and the amount of steam raised per pound of fuel are said to be remarkable.

Three-phase Power Plant at Winooski.—A brief illustrated description of this plant for supplying the city of Burlington, Vt., with electric power, is given in the "Elec. Eng.," May 15; the distance is about 2.5 miles and the capacity about 150 horse-power.

Electric Gold Dredging Plant.—The brief description of this plant in New Zealand, which was mentioned in the Digest, March 30, is given in the "Elec. Eng.," May 15.

Cooking and Heating.—The paper of Mr. Crompton, abstracted in the Digest last week, is being reprinted in full in "El'ty," beginning with the issue of May 15. A short abstract including the tables, is published in the "Elec. Eng.," May 15.

TRACTION.

Canal Boat Traction.—In a description of the well-known de Bovet system in which magnetic clutches are used, published in "Zeit. fuer Elek." May 1, it is stated that this system will probably be introduced on the Danube.

Light Railways.—An abstract of the Parliamentary discussion of the Light Railways bill, is published in the Lond. "Elec.," May 3.

Electric Railway Block System.—A system patented by Mr. Langen is illustrated and described briefly in the "Elek. Zeit.," May 2; it is an automatic block system which prevents more than one car from receiving current in a block.

Lausanne.—A report by Dr. Palaz on a project for overhead trolley lines in that city, using Dowson gas, gas engines and accumulators, is published in detail in the "Elek. Zeit.," May 2, including a table comparing this with several other electric roads in Switzerland.

Gmunden.—An illustrated description of the railway in this Austrian city, installed by an Austrian firm, is published in the "Elek. Anz.," May 2.

Nantasket Beach Railway.—The truck for this line (on which electric power is to replace steam power) is illustrated in the "Elec. Eng." and "Elec. Rev.," May 15. The former journal also gives the following information; No. 0000 copper trolley wire is to be used on iron arms bolted to wooden poles; the feed wires are bare; the poles are between the tracks; the equipment will consist of six motor cars, each with two motors of 100 horse-power; they are expected to draw a trailer; the cars are 50 feet long and entered from the side; in addition there will be four baggage cars 30 feet long two of which will have two motors and two others four motors; by loading these baggage cars the engineers intend to determine the efficiency of special motors.

Series Parallel Motor Control.—"Elec. Eng.," May 15, calls attention to a recent Patent Office decision from which it seems that this method of coupling street railway motors is public property.

Financial Value of Street Railway Franchise.—The "Elec. Rev.," May 15, reprints a short paper by Mr. Stevens.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switch.—"La Nature," May 4, publishes a good illustrated description of a small switch consisting of a short tube of insulating material closed at both ends and pivoted so that it can be moved in a vertical plane, the two metallic pivots entering into the interior which contains a globule of mercury connecting the two pivots electrically when the tube is in one position and breaking the connection when the position is reversed; the construction is simple, the form is very convenient and the contact is a perfect one; there is no oxidation of the mercury as the tube is completely sealed; as the spark is produced in the interior of the tube this form of switch can be used to advantage in mines and other places in which there is an explosive atmosphere; the switch is very highly recommended by a well-known electrician.

Budapest.—The "Elek. Zeit.," May 2, begins the publication of a report by Dr. Kittler on one of the stations at Budapest; the report consists of a very long description accompanied by a large number of illustrations.

Darmstadt.—The "Elek. Zeit., May 2, extracts at some length from the report on the operation of this accumulator station for the year 1893-4.

Electric Distribution in Office Buildings.—Mr. Pierce's article (see Digest, April 27), is continued in "Elec. Eng'ing" for May; he deals with the mistakes in the past, calls attention to the importance of the fact that the architect should confer with the electrical engineer and discusses the three prime considerations: safety, reliability and economy.

Chicago Stock Yards Lighting Plant.—A brief illustrated description is given in the "Elec. Eng.," May 15.

WIRES, WIRING AND CONDUITS.

Wiring Done by Central Stations.—The company operating the Leicester station has organized an electric light fitting department carrying out the greater portion of the wiring and the fitting in the town; the Lond. "Elec. Rev.," May 3, states that this has caused much indignation among the local electrical firms and in its opinion the proceeding is most unjust and impolitic, if not absolutely illegal.

Fuses.—According to the "Elek. Zeit.," May 2, Dr. Muellendorff and Mr. Vorreiter have overcome some objectionable features of the ordinary fuses by using lead or an alloy which may be oxidized but which does not separate into its constituent metals, and covers the wire on the outside with a thin coating of nickle or other oxidizable metal.

Underground Mains in Berlin.—The "Elek. Zeit.," May 2, contains a communication by Mr. Erhard forming a part of the discussion of the recent paper of Dr. Kallman (see Digest last week).

Conduits vs. Casings.—Lond. "Lightning," May 2, contains the conclusion of the discussion of Mr. Bathurst's recent article.

Kelvin's Law of Economy in Conductors.—Dr. Perrine's mathematical article is continued in the "Elec. Eng'ing" for May; among his deductions he shows that no maximum of economy is attained below the highest practical values for power and E. M. F.; the remaining possible cases of transmission, he states, may all be solved "by determining the current by considerations foreign to the question of the most economical cost of transmission, using the line to carry the current so determined, as given by the conditions of Kelvin's law." Various solutions are admissible on other bases of economy than those which he has used; the lowest possible cost will in general give a different result than that obtained by determining the maximum net revenue, while a maximum value might be obtained for the percentage which the net gain bears to the amount of capital used in the installation, or the maximum value of the ratio of the net gain to the total amount of capital annually used in the transmission, might be determined; he shows how each case may be represented in the equations.

Wiring Table for Motors.—A convenient table for small motors for 110 and 220 volt circuits prepared by Mr. Barriett, giving the size of wire for various distances and powers, is published in the "Elec. Eng.," May 15.

Fastenings in Walls.—The one described in the Digest, Jan. 19, is illustrated in the "Elec. Eng.," May 15.

ELECTRO-PHYSICS AND MAGNETISM.

Effects of Electric Currents in Iron on Its Magnetism.—A Royal Institution paper by Dr. J. Hopkinson is reprinted with a large number of illustrations in the Lond. "Elec. Eng.," May 3. He describes interesting experiments made with test coils encircling portions of the iron at different depths of a solid core, showing that it takes considerable time for the magnetism to penetrate the interior of a solid core; the subject matter is similar to that in a recent paper by the same author in connection with Mr. Wilson (see Digest, March 16, 23 and 30). He shows that the slowness of changes of induction depends on the largeness of the ratio of induction to the magnetizing force and therefore when this ratio is small the changes will occur comparatively rapidly while when it is large they occur more slowly; these phenomena concerning the times at which changes of inductions occur in the cores of electromagnets, have a close analogy to the retardation of signals in cables; in order to compare these the curves for the cables should show the rate of change of current and not the currents themselves, and there will then be a remarkable similarity with the magnetic curves. He shows some applications of these phenomena, a very practical one being to the cores or transformers, in which the variations of inductions diminished greatly toward the centre, the induction there being but little affected by the changing current in the magnetizing coils. The results of certain experiments showed that in practice manufacturers have laminated the iron about enough and not too much. In conclusion he indulges in what he calls a wild speculation; suppose a magnet as large as the earth surrounded by a coil having a magnetizing force of 2.5 in which the current was reversed, it would take some thousands of millions of years before the rate of disturbance at the centre attained its maximum value; he then asks if it is not "conceivable that the magnetism of the earth may be due to currents in its material sustained by its changing induction but slowly dying away."

Effect of Extreme Cold on Magnets.—In an abstract of Prof. Dewar's lecture on the scientific uses of liquid air published in the Lond. "Elec. Rev.," May 3, a brief description is given of a series of experiments on the magnetic moment of small magnets cooled to 182 degrees C.; from this it appears that every magnet has individual characteristics that may either result in no change on cooling or the addition or substraction of from 12 to 24 per cent.; a repetition of the cycle of heating and cooling brings the magnet to the steady state in which cooling always causes an increase in the magnetic strength of from 30 to 50 per cent. and the reheating brings about no loss in the original magnetic moment; he believes that such a marked alteration of magnetic strength might be used as a thermometer in low temperature research. He intends to make accurate observations of the permeability and susceptibility of the magnetic metals at the temperature of boiling liquid air.

Deviation of the Compass.—An abstract of a Society of Arts paper by Prof. Reinold is published in the Lond. "Elec. Eng.," May 3; he considers the action on the compass of the magnetism induced in the iron of the ship, and describes the methods of correcting the errors.

Alternating and Interrupted Currents.—Prof. Forbes' lecture is concluded in the Lond. "Elec. Eng.," May 3. Among some further analogies he showed a disc of paper loaded with shot around the circumference and rotated at a rapid speed; if the edge of this is bent down it appears that it retains the shape continuously for a long time. An elastic string fixed at the bottom and twisted at the top is given as an analogue of a cable of large capacity which is insulated from the earth, the twist representing the E. M. F.; the capacity is said to be a yielding and the charge is the amount of that yielding. In another case he showed a string suspended from a spring with a set of vanes and two nozzles blowing against the vanes; the string passes down through glycerine and water in a tube and at the bottom there is a mirror for reflecting the beam of light; the spring acts as a condenser and the air blowing on the vanes, takes the place of the battery, a spring below taking the place of a condenser; this is given as an analogy to the Atlantic cable. (Some of the analogies are of interest but the descriptions are not as clear as might be desired.)

Discovery of the Induction of Electric Currents.—In a Physical Society paper by Prof. S. Thompson on "A Neglected Experiment of Ampere," reprinted in the Lond. "Elec. Eng.," May 3, he stated that in 1822 Ampere made an experiment which if it had been properly followed up would have led to the discovery of the induction of electric currents nearly ten years before the publication of Faraday's results.

Contact Resistance of Metals.—The Lond. "Elec.," May 3, abstracts briefly an article by Mr. Branly from the "Comptes-Rendus," April 22; the abstract was reprinted in THE ELECTRICAL WORLD last week, p. 578.

Scientific Uses of Liquid Air.—The Lond. "Elec. Rev.," May 3, abstracts at some length, with illustrations, a recent interesting lecture by Prof. Dewar; the only portion of special interest to electricians is abstracted above under "The Effect of Extreme Colds on Magnets."

Complex Quantities and Vectors.—"Elec. Eng'ing" for May contains a short article by Mr. Dummerque on "Elements of Complex Quantities and Vectors with Reference to Their Use in Alternating Current Work," in which he gives a brief introduction and shows how such quantities are added, subtracted, multiplied and divided. An editorial in the same issue gives a brief insight into the subject of vector quantities.

Pressure in Dielectric or Magnetic Mediums.—The "Amer. Jour. of Mathematics" contains a long, highly mathematical article in French, by Prof. Duhem.

Slow Changes in the Magnetic Permeability of Iron.—Mr. Mordey's paper, which was abstracted in the Digest, March 16 and 23, is summarized briefly in the "Elec. Eng'.," May 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Ozone Bleaching Installation.—The "Elek. Anz.," April 25, gives an illustrated description of the installation at Greiffenberg; it is of interest as it is the only one of its kind and as it has been in operation for over a year; the process used is that of Siemens & Halske, and in the present installation it is used for bleaching yarn. Three-quarter bleaching is accomplished in seven hours while complete bleaching requires two or three such operations; after the bleaching the yarn is treated with chloride of calcium as usual, except that the solution is much weaker; ozone is made from the air in 60 tubes, the power being obtained from an alternator requiring three horse-power; the appearance of the bleached product is the same as when the bleaching was done by the sun and the strength of the threads was in some cases even greater; the cost is not appreciably less than that of the ordinary process; the time is much less being about one-third in summer and 1-14 in winter; the chief advantage is that the work may be done in a building, that less time is required and that the process is independent of the weather.

Purification of Sugar.—In the "Elektrochem. Zeit." for May Mr. Dammeyer gives comparative results obtained by the ordinary process and by his electric process, showing advantages in favor of the latter; in the Ottleblen factory where he made experiments with his process it has since been introduced; it is also used in a factory in Russia.

The process of Messrs. Gawalowski and Hoenig for the application of electrolysis in the manufacture of sugar, is briefly described in the same journal.

Reduction of Highly Electro-positive Metal.—According to Lond. "Engineering," May 3, Mr. Pyke at the recent Royal Society soiree showed the "Hydrogen Wall" the object of which was to obtain a greater efficiency in the reduction of the highly electro-positive metals such as potassium, from aqueous solutions; he produces an amalgam by placing the mercury in a porous vessel; the amalgam is richest at the top which is farthest removed from the liquid; the action of the device is said to be the prevention of the liberation of hydrogen at the electrolytic contact surface; in the ordinary arrangement hydrogen is liberated by local action at the contact surfaces of the mercury and the amalgam, and the full extent of the current and the direct action of the depositing current is negatived; no further description is given.

Deposition of Cuprous Oxide. — According to the Lond. "Elec. Rev.," May 3, Dr. Hammerl pointed out that the deposit from a solution of copper sulphate raised to the boiling heat, is composed almost entirely of cuprous oxide and it is suggested that probably a useful and handsome preservative coating might in this manner be applied to certain metals.

Remarkable Electrolytic Phenomenon.—The Lond. "Elec. Rev.," May 3, offers the following explanation for the phenomena noticed by Mr. Reed and described in the Digest, April 20; it is doubtless that, in case of metals possessed of little tenacity, particles are torn from the electrode by the hydrogen gas violently disengaged from its surface.

Electro-metallurgy.—A paper of some length by Mr. Moissan, read at a recent congress in Paris, is reprinted in "L'Elec.," May 4; it consists of a summary of his recent interesting researches with his electric furnace.

Antidote for Prussic Acid.—According to the "Elektrochem. Zeit." Dr. Autal has found that cobalt nitrate is the best antidote for potassium cyanide or similar compounds used in many electrolytic baths; it is given in the form of a subcutaneous injection of a five per cent. solution in quantities of 20 to 30 cb. cm., as also in internal doses.

Electrolytic Extraction of Natural Dyes.—The first part of an article by Dr. Foelsing is published in "Elektrochem. Zeit." for May.

Chemometer.—A paper with this title by Dr. Ostwald from the "Zeit. f. Phys. Chem." is translated in the "Chem. News," March 22, 29, April 5 and 11; he suggests measuring chemical energy by finding the electrical potential accompanying it by means of an electrometer; this electrometer will serve as a chemometer under certain conditions, one of them being the presence of an electrolyte.

High Voltage Cell.—According to the Lond. "Elec. Rev.," May 3, Mr. Fitzgerald made a cell the positive plate of which was of aluminum in a solution of caustic potash and the negative was a carbon plate in strong nitric acid contained in a porous pot; the voltage was 2.8; it is not adapted for ordinary use on account of the cost of working it, but is of interest from a theoretical point of view.

Tin-Chromic Chloride Cell.—The Physical Society paper by Mr. Skinner, abstracted in the Digest, March 9, is published in full with the illustration in the "Phil. Mag." for May.

Thermo-Chemical Carbon Cells.—A German translation of the recent

paper of Mr. Korda abstracted in the Digest, May 4 (see also May 11), is published in the "Elek. Zeit.," May 2.

Electrochemical Gold Extracting Process.—The following new process recently patented by Dr. Gaze, of New Zealand, is described in "Eng. and Min. Jour.," May 11. The solution is chloride of bromine; a number of porous cells filled with water and containing carbon rods, are placed in a large vessel which is filled with a strong solution of chloride and bromide of sodium, with carbon rods immersed in it; on passing a strong current through this, chloride of bromine is formed; this is drawn into a vat containing the crushed ore in a close vessel under a pressure of 50 pounds to the inch and left there for one or two hours, during which time the whole of the gold is dissolved; after filtering, it may be used again until it is rich in gold or weak in solvent power; it is then run into an electrolytic cell similar to the one described above and a strong current passed through it, producing chloro-bromic acid which liberates the gold in the form of a purple powder; the solvent tends to split up as the solution becomes charged with hydrochloric and hydrobromic acids; this he neutralizes with caustic soda which produces the original salts; any gold in this solution is recovered by electrolytic deposition.

Electro-Metallurgy of Gold.—A second letter by Mr. Andreoli on "Is the Use of Cyanide Potassium for Gold Extraction, Public Property?" is published in the "Eng. and Min. Jour.," May 11; it refers to the recent litigation in England.

Electrolysis of Gold.—A brief abstract of Dr. Keith's recent paper (see Digest, April 6, 13, 27, May 4), is published in "Elec. Eng.," May 15.

Local Action in Accumulators.—A translation of the article by Mr. Darrieus which was abstracted briefly in the Digest, Dec. 15, is reprinted in the "Elec. Age," May 4; (the translation is the same as the one in the Lond. "Elec. Rev.," Jan. 11, mentioned in the Digest, Feb. 2, although no acknowledgment is made).

High Voltage Battery.—According to "El'ty," May 15, the following cell has recently been described (but where, is not stated): metallic magnesium is placed in a solution of ammonium chloride, and a plate of copper in a solution of cupric chloride and hydrochloric acid; the E. M. F. is three volts and the internal resistance quite low; the current is said to be constant for long periods; no further information is given.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Specific Resistance of Brasses.—"Elek. Zeit.," May 2, contains an article by Dr. Haas in which he gives the results of very carefully made tests to determine the specific resistance and the temperature coefficient of a large number of alloys of copper and zinc; he was prompted to make these researches as existing data was scant and unreliable. He made 28 alloys with different proportions of zinc; the copper and zinc were very pure and were carefully melted so as not to introduce impurities; of these alloys only those containing less than 50 per cent. of zinc could be drawn out into wires, the others could not be worked on account of their hardness and brittleness; 32 tests were made with each wire; the proportion of the constituents was determined by analysis. The results are given in the following table:

Reference number.	Percentage of zinc.	Specific resistance in ohms.	Temperature coefficient.	Specific conductivity.
1	0	0.01576	0.004316	63.45
2	0	0.01592	0.004328	62.81
3	0.71	0 01833	0.003725	54.56
4	1.56	0.02133	0.003185	46.88
5	3.07	0.02372	0.002913	42.16
6	5.51	0.03010	0.002483	33.22
7	9.08	0.03638	0.002044	27.49
8	18.02	0.04763	0.001691	21 00
9	20.29	0.05064	0.001639	19.75
10	22.71	0.05424	0.001607	18.44
11	28.16	0.05826	0.001581	17.16
12	34.23	0.06302	0.001579	15.87
13	40.28	0.05789	0.002116	17.27
14	42.55	0.05307	0.002376	18.84
15	45.19	0.04712	0 002851	21.22
16	46.85	0.04314	0.003105	23.18
27	99.54	0.05883	0.003847	17.00
28	100.00	0.05683	0.004029	17.60

The resistance of the alloys was found to be a linear function of the temperature; curves constructed from the data in the table showed that the specific resistance increases rapidly at first with the percentage of zinc, up to about 5 per cent., reaches a maximum of 34 per cent. after which it diminishes again; alloys containing 14 and 47 per cent. of zinc have the same specific resistance; the curve, if continued still farther, would have another point of inflection, ascending again. From the curve representing the temperature coefficients, the latter falls rapidly at first with increasing amounts of zinc up to 5 per cent., then gradually being nearly horizontal between 17 and 30 per cent. after which it rises quite rapidly; the mimimum is at about 33 per cent. With 34 per cent. of zinc it will therefore be seen that there is a maximum of the specific resistance with a minimum temperature coefficient; this proportion corresponds to a molecule of two atoms of copper and one of zinc, from which he concludes that copper combines chemically with zinc in that particular alloy.

Magnetic Tester for Measuring Hysteresis in Sheet Iron.—The discussion of Prof. Ewing's paper (see Digest last week) is published in full in the Lond. "Elec.," May 3. Dr. Fleming thought it would be simpler to revolve the magnet. Prof. Ayrton questioned whether it was right to assume that the ratio of the hysteresis of different irons with different inductions, was the same; he describes an instrument which he made some years ago for obtaining the B-H curve quite quickly; it consisted of a small separately-excited dynamo, the specimen to be tested forming the yoke having a coil of wire encircling it; the armature was rotated by a small motor at a fixed speed, a voltmeter being connected to the brushes; an ammeter inserted in the circuit of the coil around the yoke piece, gave the magnetizing current and the voltmeter the corresponding induction in the iron; by merely alternating the resistance a series of points on the curve was easily obtained; it has the disadvantage that if the hysteresis is to be determined the area of the curve has to be taken, but it enabled the permeability to be measured at the same time. Prof. Forbes stated that one could not trust to hysteresis being proportional in different specimens of iron at different intensities; he thought that the eddy currents in the iron itself might possibly be quite perceptible; he recalled an apparatus made by Prof. Elihu Thomso some years ago in which the sheet iron was cut into circles which were piled up into a small cylinder mounted on a pivot and retained in position by a spiral spring; a field was then rotated around the cylinder and the deflections produced by the torsion due to hysteresis were measured, the deflection being proportional to the force required to overcome that. Mr. Siemens stated that it was very necessary to avoid as much as possible all handling of the pieces to be tested; he did not think that the state of the iron could be gotten back again by annealing; the only drawback to the instrument was that the pieces required filing which would at once make the results quite different; he preferred to continue to use the ballistic method in his shops. Mr. Bailey suggested that there would be a certain amount of demagnetization of the specimen under test. Mr. Trotter thought that the hardening of the edges by shearing ought to be allowed for. In reply Prof. Ewing stated that the reason why the specimen and not the magnet was made to revolve was that if the specimen be made the stable body it should always have precisely the same amount of mechanical stability, which is hard to secure in practice; regarding the fanning action he stated that there was no material effect produced by the carrier when wood was substituted for iron; he gave sufficient proof of the unimportance of eddy currents; regarding the annealing, his experience was that if the annealing was done in the same way it produced the same results each time; regarding Prof. Ayrton's instrument he stated that for the B-H curve was obtained after a great deal of work, the results had to be reduced to absolute values, the curve drawn and the area measured; in practice the pieces would probably be stamped like the transformer plates themselves.

The same issue contains a communication by Mr. Addenbrooke in which he mentions some experiments of his own confirming the unexpected results of Ewing, namely, that the readings of the instrument were not affected materially by variations in the number of sample sheets used; 45 strips of armature iron were tied in a bundle fixed between the poles of a U magnet, leaving an one-fourth-inch air gap between the ends of the samples and the other pole; a pull of four ounces was required to detach the magnet from the armature (the pull being in the direction of the laminations, that is, perpendicular to the pole of the magnet and apparently tended to detach the iron from one pole and pull it toward the other); they were then removed and one sheet substituted for them reducing the section to $\frac{1}{45}$ and the pull was then eight ounces or double what it was before; the greater coercive force with the fewer sheets increased the hysteresis as the section of the iron is diminished and so secures a balance over a certain range.

Submarine Cable Testing.—The Lond. "Elec.," May 3, continues the serial by Mr. Wilkinson on "Notes on Submarine Cable Work" the first parts of which were published in that journal about two years ago; he intends to consider electrical tests for the localization of faults and breaks, adhering to the practice and methods in common use to-day; in the present portion he describes the earth overlap tests and the earth overlap as a loop.

Apparatus for Testing Lightning Rods.—A brief description of an apparatus is published in "L'Eclairage Elec.," April 20.

Portable Testing Set.—An illustrated description of a complete set, made in England, for testing installations is given in "L'Elec.," May 4.

Conductor Materials.—"Elec. Eng'ing" for May contains an article by Dr. Perrine in which he gives the general elementary formulas for the resistance of wires and discusses the specific resistance of copper, calling attention to the effect of impurities, most important of which is the suboxide of copper; the brittleness of electrolytic copper he accounts for by the presence of hydride of copper formed in the deposition, and the brittleness and low conductivity of over-refined fused copper is due to the presence of carbide of copper formed in the presence of carbon as

soon as the suboxide disappears; the electrolytic copper which has been carefully melted or which has been so deposited as to avoid the formation of the hydride, invariably has a conductivity several per cent. above the Matthiessen standard; he gives a table of the relative conductivities of copper alloyed with other substances showing that a very serious reduction of conductivity is produced by even a small percentage of alloyed material.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Carbonelle Microphone.—According to the Lond. "Elec. Eng.," May 3, some tests were recently made by the Belgium Government under the direction of Mr. Banneux who considers that they have not proved the superiority of the Carbonelle system (described in Digest, Jan. 12), over the transmitters such as Hunnings, Grunewald, etc.

Telephone Service in England.—The Parliamentary inquiry is reprinted in the Lond. "Elec. Rev." and Lond. "Elec.," May 3.

Telephony in Denmark.—A brief description is given in the "Elek. Zeit.," May 2.

Domestic Telephone Apparatus.—An illustrated description of a German system is given in the "Elek. Zeit.," May 2.

Switzerland.—The "Elek. Zeit.," May 2, abstracts some general statistics regarding telegraphy and telephony in Switzerland for the year 1894.

Comparative Telegraphic Statistics for 1893.—The "Jour. Teleg.," April 25, publishes its annual table of statistics.

History of the German Telegraph Department.—The "Elek. Zeit.," May 2, in an editorial reviews briefly the development in this department for the last 25 years during which time it was under the direction of Dr. von Stephan.

Laying a Cable from Zara to Pola.—A description of the laying of this cable is published in "Zeit. fuer Elek.," May 1.

Semaphore Signals.—The Fiedler signal, which is operated electrically, is described in the "Elek. Zeit.," May 2, by Mr. Kohlfuerst.

Electrolysis of Underground Telephone Cables in Milwaukee.—"Elec. Eng'ing" for May reprints a recent paper by Mr. Dexter giving a sketch of the conditions found in the subways of the Wisconsin Telephone Company a year ago, and the measures taken to alter these conditions in order to prevent damage to the lead cables through electrolysis; a complete map of the system was made showing the voltage between the cables and the earth in each manhole; the results of a number of these measurements are given; in one case a current of 27 amperes at five volts was found flowing from the water main to the cable; out of 144 manholes the cables in 35 were positive to the earth while in the majority they were negative with a maximum of six volts, in which the current flowed from the earth to the cables; at these points there is nothing to fear but at the points where the current was leaving the cable to the earth it was destroying the covering. The cables were cleared and covered as much as possible with asphalt paint and number 0 copper wires were run from a number of manholes connecting the cables with the negative bus bar at the railway power house; this changed the readings from a positive to a negative value; this system of wires carries a current of 210 amperes back to the station; in all of the manholes the cables are at present negative with regard to the earth and there is now no point in the system where the current leaves the cables except by the copper conductors; no destroying effect is therefore taking place.

Telephone for Mines.—A brief illustrated description of a set made by the Bell Company adapted especially for mines, is published in "Eng. and Min. Jour.," May 11; in this it is claimed that the difficulties due to the corroding action of dampness and gases have been overcome; as few metal parts as possible are exposed; wood was found to be the best material to use; it is thoroughly creosoted and covered with waterproof paint.

Chicago Telephone Company.—"Elec. Eng'ing" for May contains an editorial by Mr. DeLand stating some facts correcting a recent article in a contemporary.

Genesis of the American Electric Telegraph.—An abstract of a recent paper by Mr. F. L. Pope including portraits of Morse and Vail is published in "Elec. Eng.," May 15.

Fire Alarm System.—The "Universal" system is described and illustrated in the "Elec. Eng.," May 15.

Fire Telegraph.—That used in Brooklyn is described and illustrated in the "Elec. Age," May 11.

MISCELLANEOUS.

Superficial Carburation of Armor Plates.—According to "L'Eclairage Elec.," April 20, Mr. Garnier suggests an application of electricity for facilitating the operation of superficially hardening armor plates; in the well-known Harvey process the plates are covered with charcoal and then heated. Mr. Garnier suggests to facilitate the operation by making the plate the cathode and covering it with a thin coating of charcoal over which is placed a plate of sheet iron which latter forms the annode; a current of 50 amperes at three or four volts is then passed through this while the whole is heated to a red heat; the action takes place sufficiently rapidly that there is no fear of burning the metal. The method has not yet been tried in practice but the researches have established the fact, which he says is not generally known, of the possibility of transporting carbon by means of electricity from the positive to the negative pole. He is now making experiments to use the electric current in conjunction with heat to eliminate from metallic baths the objectionable metalloids such as sulphur or phosphorus and also to separate the alloyed metals; the results already obtained applied to nickle showed that this method has a future.

Laboratory Apparatus for Producing Calcium Carbide.—A simple form of apparatus is described and illustrated by Dr. Krueger in the "Elektrochem. Zeit." for May. A current of 75 amperes and 40 volts is said to be sufficient, although 90 to 120 amperes is preferable; the furnace consists simply of a graphite crucible holding about one pint, around the outside of which is fastened a closely fitting iron ring which serves as a contact for the leads; the second electrode is an ordinary carbon rod as used for arc lamps; 56 parts of burnt lime and 36 parts of coal are finely pulverized and well mixed; after the arc is established this is introduced little by little into the crucible; 100 grams of the carbide can be produced in a short time; he prefers mixing the pulverized material with a dilute solution of sugar and working it into small lumps which are then introduced into the crucible. He describes a lamp for burning acetylene and the process of making alcohol with the aid of this gas.

Torpedos.—A lecture by Mr. Stehlik is briefly abstracted in the "Zeit. fuer Elek.," May 1.

Royal Society Soirée.—Very brief descriptions of a number of interesting exhibits at the first annual soirée of the Royal Society are published in the Lond. "Engineering," May 3; most of those referring to electrical subjects have already been described in these columns.

Patent Law.—The "Forum" for May contains a well-written article by Prof. Thurston on "Our Debt to Inventors: Shall We Discourage Them?" in which he points out that the modern material advancement practically dates from the time of the general recognition of the inventor's rights and shows that a spirit diametrically opposite to the one in which the patent system was conceived, has sprung up within a few years, referring in particular to the recent decision in the Bates case which he says must inevitably result in the repression of the inventive spirit; the law as it stands he says is an insult and a direct injury of enormous magnitude to the inventor. A portion of this article is reprinted in the "Elec. Age," May 11.

Patents.—"Elec. Eng'ing" for May contains a short article by Mr. Smith on "International Agreements about Patents."

Biographical.—The "Amer. Mathematical Monthly" for January contains a portrait and biography of Dr. Macfarlane.

New Books.

STREET RAILWAY INVESTMENTS.—A Study in Values. By Edward E. Higgins. 102 pages, with folding table, 16 x 48 inches, in pocket. New York: Street Railway Publishing Company, 1895. Price $2.

This book is designed to give information to those who have money to invest, as to the safety of street railway investment, and the probable returns therefrom. As the author is not in the position of a promoter and has no axe to grind, he has endeavored to strip the mask from ingeniously arranged accounts, and show the prospective investor just what he may expect of his money if he bestows it in this field.

The author has rejected all accounts that seem to him unreliable, and has arranged all those that he approves in a shape to admit of easy interpretation. He brings to the front one of the great evils of street railway systems—over capitalization. Organizers capitalize a system for what they think it will bear, and not for its true value. In the case of street railways, values have so greatly depreciated, and ignorant planning, management and construction, together with enormous cost of remodeling, have combined to make the cost and the true value of a railway system widely different.

As a general thing the prospective investor will find it more difficult than any one else to obtain bottom facts. Managers and organizers frequently tell the truth, a less number tell nothing but the truth, and those who tell the truth, the whole truth and nothing but the truth to the prospective investor are rare indeed. Hence such a discussion as Mr. Higgins presents seems to be of special value.

The work is a financial history of the street railways of the United States. It divides them into seven classes and, taking a chapter for each class, discusses specimen cases therein. The author has crowded a great deal of information into the 102 pages of the book, and has drawn clear and concise conclusions from his discussions.

Street railway investors can be guided by what has been done only by judicious reasoning. The remodeling of horse railways has been nearly completed and the construction of new roads with a full knowledge of how to proceed presents a very different case. This point is also ably discussed by the author. The prospective investor will have little difficulty in selecting parallel cases to that which he is considering for two reasons; first, the case is there, and, second, it is so classified that it may be readily found. The author has added to the book itself the

financial statistics of 145 different roads. These statistics he has divided into two parts—capitalization and operation. The roads are arranged in the order of the population they serve, those of the least populous cities coming first. Interurban roads have a separate classification.

Organizers and promoters should have this book as well as the investor. Financial enterprise has been full of blunders that can be avoided by a study of previous cases and wherein and how they succeeded or failed.

POPULAR SCIENTIFIC LECTURES. By Ernst Mach. Translated by Thomas J. McCormack. Chicago: The Open Court Publishing Company, 313 pages, 44 illustrations. Price, $1.50.

Prof. Mach has the rare faculty of treating the most abstruse scientific subjects in a popular style, without in the least sacrificing scientific accuracy or philosophic breadth of view. The range of his subjects is also extremely wide, in the present work there being chapters on the principles of the conservation of energy, on instruction in the classics and the mathematico-physical sciences, on the fibres of Corti, on the fundamental concepts of electrostatics, "Why Has Man Two Eyes," and other topics similarly varied in character.

The chapter on the "Principles of the Conservation of Energy" is made of unusual interest from its method of treatment, which is based upon the evolutionary plan, the various ideas being taken up at their origin, and follows to their full development. In tracing the growth we are brought into human contact with those who contributed to it, the personal element being always kept well to the fore. The system employed by Prof. Mach has indeed much of the human in it, for the manner of development of an idea reminds one of a real process of growth; we see the infant pass into boyhood and through youth to maturity, and note the influence of the various great minds that presided at different stages of growth.

The chapter "On the Fundamental Concepts of Electrostatics" is a lecture delivered in 1883 at the International Electrical Exhibition at Vienna, and while rather elementary in extent yet teaches clearly and soundly the fundamental principles upon which electrostatics is based.

A Novel Telephone Transmitter.

The accompanying illustration shows the construction details of the telephone transmitter made by the United States Telephone Construction Company, of Philadelphia. It will appear at a glance that it is neither a Blake nor a Hunnings, nor yet a granular carbon (solid back) transmitter; in fact, it is not exactly like any of the most familiar types.

The diaphragm is of India mica and has attached to its centre a small aluminum cup holding a carbon or other suitable point. In front of the black rubber shell is shown the basket or runway of aluminum. The sphere shown in the cut is made of carbon and is $\frac{1}{16}$ of an inch in diameter; this ball normally lays in the aluminum basket or runway, which is so constructed that no matter which side of the transmitter is up, the sphere rests on a plane which is always inclined toward the back of the basket is about three fourths of an inch, allowing the carbon ball a maximum movement of not quite one sixteenth of an inch. It is said that with every vibration of the diaphragm the movement of

NEW TELEPHONE TRANSMITTER.

this carbon ball breaks the battery current, hence the trade name of the instrument, "M. & B," which signifies "Make and Break."

The features claimed for the transmitter are clearness of articulation, great volume of sound without any sputtering or similar disadvantages, long distance transmission and simplicity of construction.

Electricity in Coal Handling.

An extensive coal handling plant, operated entirely by electricity, has been running in San Francisco for the past few months with much success. The plant is of the most modern character in every respect, and is the second important coal handling plant operated by electricity installed in this country. The owners, R. Dunsmuir & Sons, being confronted with the problem of how to unload coal rapidly from steamships and colliers at the wharves and distribute it to the wholesale and retail trade, most economically, found the solution in the adoption of electrical apparatus.

The plant consists of an electric hoisting and haulage system for unloading the coal-carrying ships and steamers and distributing the coal into wharf and house bunkers for local and wholesale distribution. The wharf bunkers are built out upon a pier by the side of which colliers are moored for discharging, and the house bunkers are located in the main yard and connected with the wharf bunkers by means of a trestle and bridge 204 feet long, and 35 feet above the level of the street.

The power house is a frame building 81 feet long by 88 feet in width, and contains a 300-hp boiler plant and two tandem compound McEwen

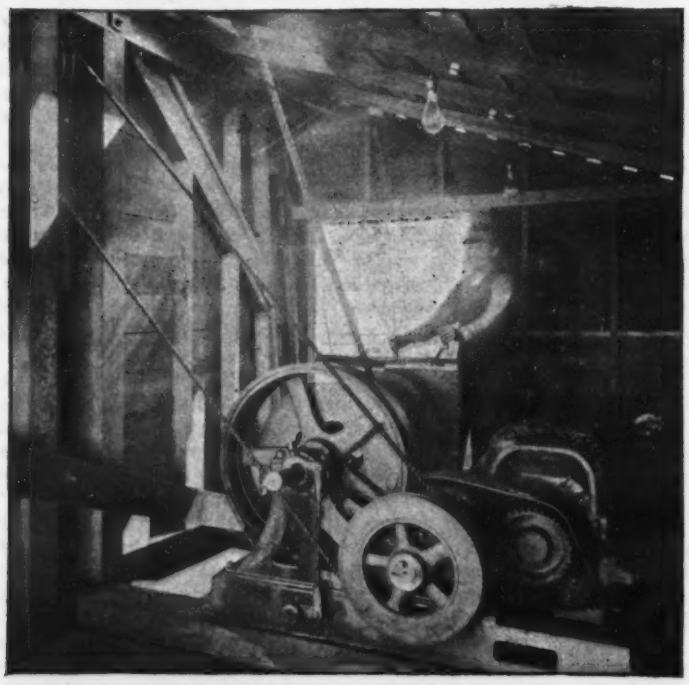


FIG. 1.—ELECTRIC DERRICK.

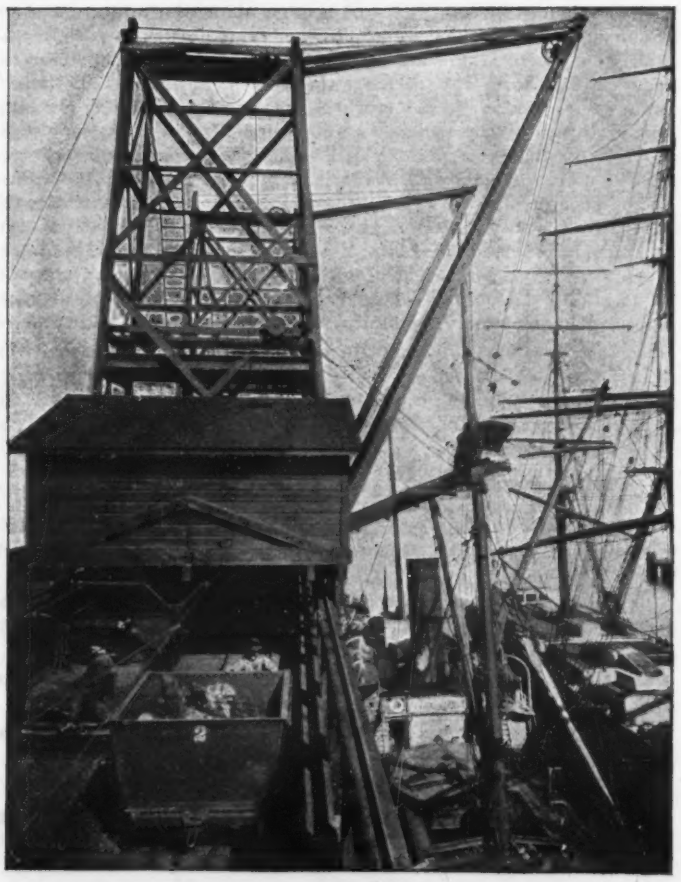


FIG. 2.—VIEW OF ELECTRIC DERRICK AT WORK.

high speed engines, rated at 135 horse-power each, belted to two 90-kw, 250-volt multipolar General Electric dynamos, running at 700 revolutions and over-compounded 10 per cent.

The hoisting plant consists of three special electric hoists, each having a capacity of 2,000 pounds lifted at a maximum rope speed of 800 feet per minute. An excellent view of one of these hoists is given in Fig. 1.

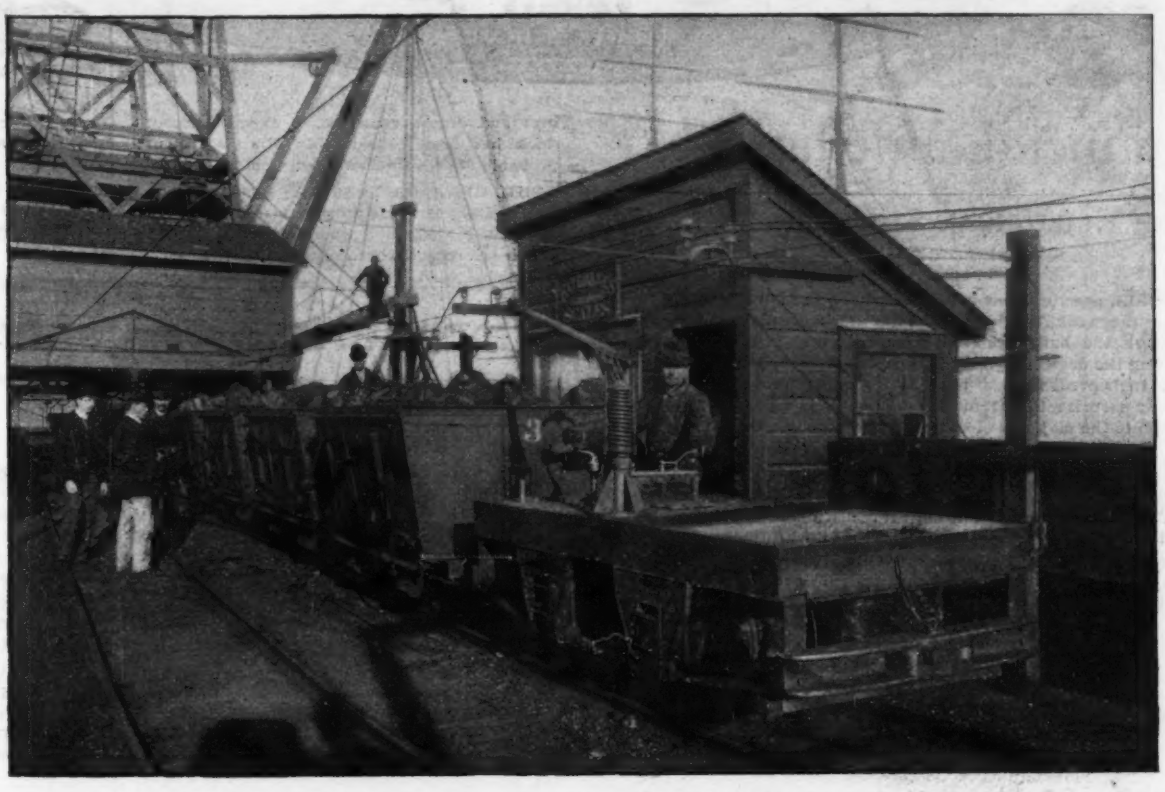


FIG. 3.—ELECTRIC LOCOMOTIVE AND COAL TRAIN.

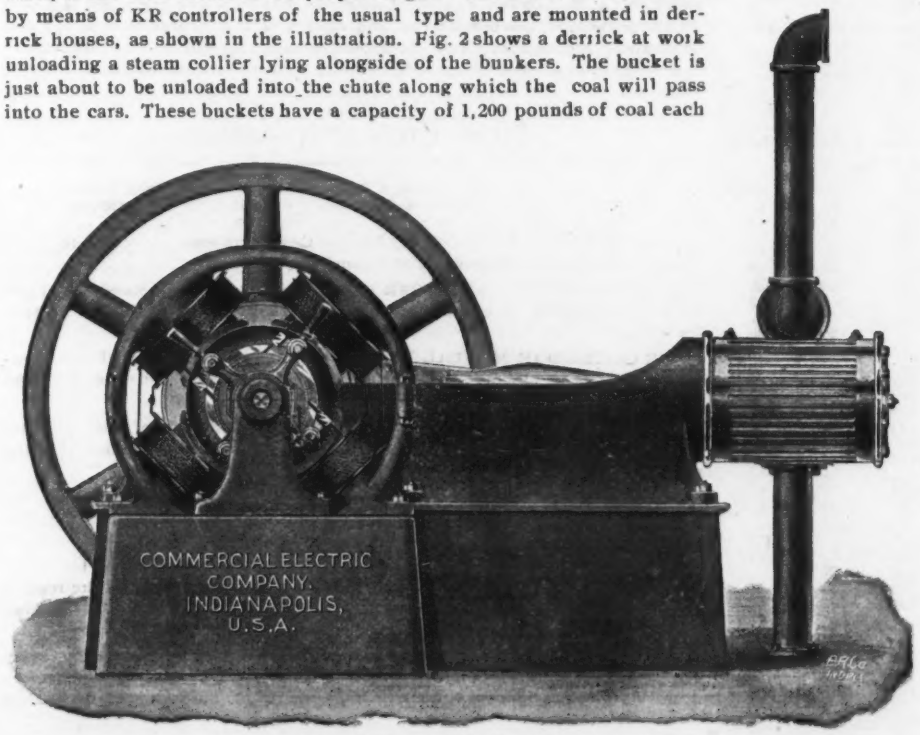
The motor is of the General Electric L. W. P. 2-type and the armature shaft is geared to an intermediate shaft by special gears with a very slight reduction in speed. The intermediate shaft is in turn geared to the winding drum shaft by means of eight-groove friction drums. On the end of the intermediate shaft is also a single groove wheel driving the hauling-in drum which serves to haul the bucket in over the chutes when it has been raised to the proper height. The hoists are controlled by means of KR controllers of the usual type and are mounted in derrick houses, as shown in the illustration. Fig. 2 shows a derrick at work unloading a steam collier lying alongside of the bunkers. The bucket is just about to be unloaded into the chute along which the coal will pass into the cars. These buckets have a capacity of 1,200 pounds of coal each and are raised from a depth of 60 feet to 80 feet, according to the state of the tide and the portion of the hold from which coal is taken.

The derricks are mounted on a track raised about six feet above the floor of the bunkers, and are so arranged that they can be moved along the wharf to accommodate themselves to the position of the hatches of the ships. The capacity of each derrick is 400 tons in nine hours, although they have, under favorable conditions, worked up to 450 tons in nine hours.

A portion of the coal is unloaded by the derricks directly into the bunkers on the wharf, but the larger portion is discharged into cars and hauled to the house bunkers by electric locomotives. Fig. 3 shows one of the electric locomotives, of which two are used for this haulage work, with a train of four cars being weighed on the scales before delivery to the house bunkers. The locomotive is of the T. M. F. type and is equipped with General Electric motors. It has a draw-bar pull of 800 pounds and is required to haul from four to six loaded cars, each car weighing 3,600 pounds and having a capacity of 4,700 pounds of coal. The tracks are perfectly level and on the return trip the locomotive frequently brings back 8 to 10 empties.

On the bridge the usual overhead railway construction has been adopted, while on the wharf a special construction was rendered necessary on account of the limited head-room underneath the derrick.

The firm's bunkers handle about 250,000 tons of coal per annum and the adoption of electrical apparatus for hauling and hoisting under these conditions is significant.



DIRECT CONNECTED MULTIPOLAR DYNAMO.

Direct Connected Generator.

We illustrate herewith a direct connected generator manufactured by the Commercial Electric Company, of Indianapolis, Ind. The dynamo is of the familiar multipolar type, and has massive soft cast steel field magnets. The armature is of the smooth core, Gramme ring type, it being claimed by the makers that this type gives the most perfect regulation, greater freedom from sparking and less tendency to heat than the iron-clad type commonly used. The maximum rise in temperature at full load is guaranteed to be less than 75 degrees Fahr., and the regulation within one volt, from no load to full load.

The armature is mounted on the shaft extension of the engine, and the magnet frame is bolted upon the extension to the engine sub-base. The armature and commutator are mounted on the same spider, so that the complete armature may be removed from the shaft without disturbing any of the connections.

The machine illustrated is a 40-kw incandescent lighting dynamo, connected to a Ball engine.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 18, 1895.

AMERICAN BELL practically monopolized what attention the electrical list received during the week, the balance of the stocks displaying no particular activity. Although the bulls declare that the decision of the circuit Court of Appeals, reversing the decree of Judge Carpenter, was only to be expected and simply confirms their predictions, it is highly probable that the decision came as something of a surprise to the most sanguine Bell adherents, and it was certainly a bomb to the majority of traders as well as to the electrical fraternity at large. The stock, of course, is on a boom just now, as a consequence of the decision.

GENERAL ELECTRIC is said to have lost some of its best friends by reason of the G. E.-Westinghouse fizzle. The objection attributed to some of the General Electric directors that the deal would have resulted in more benefit to the Westinghouse company than to the General Electric is given as the explanation of the failure to carry the deal through. The resignations of Messrs. Mills and Twombly have had no apparent effect upon the stock, and the selection of the gentlemen elected to succeed them would seem to imply that the control of the General Electric has been transferred to Boston.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	100½
" " " Brooklyn	100	..	108
" " " Boston	100	130	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	..
General Electric	100	34	34¼
General Electric, pref	100	..	65
Westinghouse Consolidated, com.	50	34¼	34¾
" " pref	50	52	52½

BONDS.

Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	198	199
American District Telegraph	100	30	40
American Telegraph & Cable	100	92	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57	57⅛
Gold & Stock Telegraph	100	105	..
New England Telephone	100	69½	70
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63¼	..
Western Union Telegraph	100	92¾	92⅞

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18⅛	18½
Binghamton RR. com	100	100	..
Brooklyn Traction	100	13½	14
" " pref.	100	..	53
Buffalo St. Ry	100	70	72
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48¼	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	73½	74
Long Island Traction	100	9½	10
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	95	96½
New Orleans Traction	100	14½	16
" " pref.	100	56	60
North Shore Traction	100	23	28
" " pref.	100	88	93
People's Traction $30 pd	25	59½	60¼
‡Philadelphia Traction	50	82½	82¼
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	..	69
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	83	87

BONDS.

Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railroad Co. 5s	100	99	00
*Columbus St. Ry. 1st 5s	100	98	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

* With accrued interest.

† Ex-Div.

‡ Ex-rights.

BALTIMORE TRACTION is showing considerable strength, though not a great degree of activity, which is most likely due to steadily increasing earnings and a more conservative expense account The floating supply of the stock has been considerably diminished, but a further advance is scarcely probable until a further absorption takes place.

PHILADELPHIA TRACTION shows signs of an advance in the near future despite its present sluggish appearance. It is more than likely that the stock has been held down deliberately to accomplish the accumulation of holdings which has recently been observed.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, May 20, 1895.

ALBERT L. CLOUGH, general manager of the Brodie Electric Company, Manchester, N. H., was in New York last week and called at the office of THE ELECTRICAL WORLD.

THE SUBWAY MONOPOLY BROKEN.—Judge Follett, of the Supreme Court, has affirmed the lower court's judgment against the Empire City Subway Company in its suit to restrain the Broadway and Ninth Avenue cable companies from placing telegraph and telephone wires in their cable conduits.

THE POSTAL BUILDING LEASE.—The Trinity Church Corporation has leased to John W. Mackay the property at Broadway and Murray street on which is the Postal Telegraph building, for a term of 20 years, at an annual rental of $52,500. Mr. Mackay got a lease on this land in 1892 for a period of three years, in which it was specified that he should erect a building, and having fulfilled this condition the term is now extended for 20 years.

BROOKLYN TROLLEY TROUBLES.—The conductors and motormen of the street railways in Brooklyn are now complaining because the schedules require them to run so slowly that they cannot earn fair wages. The demand upon the city government to make the movement of street cars safer was so importunate that the rate of speed in the busiest part of the city was ordered reduced to six miles an hour, and this makes the through time slower than is customary where horses are used.

THE MORSE CLUB will give its first annual dinner at 7 o'clock, p. m., on Friday, May 24, at Jaeger's corner, Madison Avenue and Fifty-ninth street. Addresses will be made by Messrs. Albert B. Chandler, Thos. F. Clark, Wm. J. Dealy, W. A. Van Orden and W. C. Burton. The club was organized last year for the purpose of celebrating the anniversary of the transmission of the first telegraphic message and other important events incident to the institution of the telegraph and the life of Prof. Morse; and to decorate the Morse statue annually.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, May 18, 1895.

THE LIMITING SPEED FOR TROLLEY CARS has been increased to eight miles an hour by the Newtown City Council.

HARTFORD'S LAST HORSE CAR was run into the barn on Monday last and taken out of service. Every line in the city is now fully equipped with the trolley system.

THE CAMBRIDGE MANUAL TRAINING SCHOOL has appointed City Electrician Charles H. Morse to the superintendent's position made vacant by the death of Henry Ellis.

PORTLAND, ME.—The long uncertainty about the building of the Portland & Cape Elizabeth Electric Railway is developing in a general belief that the road will be built this summer.

A TEMPORARY INJUNCTION has been granted by Judge Chipman, of the United States Circuit Court, against the Bryant Electric Company, of Bridgeport, Conn., enjoining it from manufacturing the Bergman keyless lamp socket.

MIDDLETOWN, CONN.—The refusal of the railway committee of the legislature to grant the Middletown Horse Railway a charter to extend the road to Meriden, by way of Westfield, will not, it is believed, have the effect of stopping the road.

THE WEST END STREET RAILWAY COMPANY will electrically equip all its remaining Somerville horse lines this summer—some seven or eight miles. A new car house will be built somewhere near the terminus at West Somerville.

ANSONIA ELECTRIC DIVIDEND.—C. S. Mersick, receiver of the Ansonia Electric Company, has been authorized by Judge Prentice to pay a dividend of 10 per cent. to the creditors of the concern. This is the second dividend of 10 per cent. that the receiver has paid.

WALTHAM'S MOODY STREET LINE of railway has been at a dead standstill recently owing to lively differences of opinion between the city authorities

and the street railway officials. Matters were adjusted this week, however, and the construction work is progressing rapidly.

UNDERGROUND WIRES.—Commissioner Murphy has requested the superintendent of streets to grant permission to the New England Telephone & Telegraph Company to put underground conduits in several streets. The Boston Electric Light Company will begin putting its wires underground in Atlantic avenue and Winter street immediately.

AN OPPORTUNITY for profitable investment seems to be presented by the topography of Shelburne Falls, Mass., and vicinity. Just above the village water power aggregating 2,500 to 3,000 horse-power, it is said, may be utilized by the construction of a 20-foot dam at Scott's bridge and a tunnel thence to a point below the stone quarry. There is a natural fall of 50 feet in the river and the dam would raise it 70 feet. Shops near the Fitchburg railway could use 45 feet of the total head, leaving 25 available on the river bank below. The water supply is said to be reliable.

FOUR ELECTRIC LAUNCHES are to be placed in waters within the limits of the Metropolitan Park system for public accommodation this season. Two of these will be moored off City Point, the Marine Park reservation, and the other two will float on the bosom of Jamaica Pond. This will be the first time that any public boats, with electricity for the motive power, have been floated in this vicinity, and now that the first step is made here it is not improbable that there will be a general awakening to the important uses to which electricity can be put on the water as well as on the land.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, May 8, 1895.

AN INTERESTING EXPERIMENT.—At the conclusion of a lecture at the Royal Institution on Tuesday, Prof. George Forbes showed a very interesting experiment which originally was due to Lord Armstrong. As this experiment seems to throw some light on the changes in insulation resistances of bare copper conductors laid in conduits, it is of interest to electrical engineers. The apparatus used consisted of an inner and an outer glass vessel communicating by a small orifice in the bottom of the inner vessel. Both these vessels were filled with distilled water, and some cotton thread was placed in the inner one, the end of the thread being passed through the orifice. On sending a high pressure continuous current from the outer to the inner vessel the thread was seen to move bodily through the orifice in the opposite direction to the current while water streamed from the outer to the inner vessel. On reversing the current the thread receded into the inner vessel and the water streamed outward. It has been thought that this effect may explain the increase of the insulation resistance of the positive conductor and the decrease of the insulation resistance of the negative conductor in an underground system of bare mains.

SERIES GLOW LAMP LIGHTING.—A system known as the "Parfitt" system of lighting is just now being made much of in this country. So far the only actual lighting by this method is that of two parishes near Bristol. It is, however, now proposed to form a company on the strength of a patent belonging to Mr. Parfitt, and the experience gained in this out-of-the-way district, and for the purpose of making the thing go through several extravagant claims have been put forward. For instance, it is pointed out that the total cost of generating a board of trade unit under this system has been found to be only 2½d as against 4d and 5d elsewhere. This is a somewhat disingenuous statement, since on inquiry it is found that a continuous supply is not offered by Mr. Parfitt, whilst those concerns where the total cost of generating amounts to double his figure, have to maintain a supply night and day. Mr. Parfitt's system is nothing more than our old friend series glow-lamp lighting. The main feature which differentiates it from others hitherto tried with such small success, consists in the means employed to prevent the extinction of one lamp interfering with the rest. At the most, the failure of the automatic switch cannot lead to the extinction of more than one additional lamp.

AN ELECTRIC CITY OF NOTE.—In a paper read by Mr. Arthur Wright, the municipal electrical engineer of Brighton, before a recent gathering of the Incorporated Association of Municipal and County Engineers, it was pointed out that Brighton is a city of some note in the annals of electricity It was the first town in England to possess a central station for the express purpose of general public supply, it was the first town to use meters, to adopt the differential system of charging for electricity based on the actual cost of supplying it to each individual customer. It has, moreover, during the past 10 years, enjoyed the advantages of the multiple-series system, the house-transformer system, and the two and three wire system, and now the northern portion of the town is being supplied during the hours of heavy load, on the alternating system, and during the hours of light load, on the continuous current system. The municipal Engineer also points out, that, notwithstanding the fact that coal at Brighton is 20s. per ton, the actual cost of supplying electricity from the Brighton municipal central station is less than from any other central station in Great Britain, the figure being 2.3d per unit as against 2.46d at Liverpool, 2.69d in Westminster (London), and so on; this figure being exclusive of redemption and interest.

General News.

NEW INCORPORATIONS.

THE TEXAS ELECTRIC COMPANY, Austin, Tex., has been incorporated with a capital stock of $5,000.

THE TAYLOR ELECTRIC LIGHT COMPANY, Taylor, Tex., has been formed: the capital stock is $20,000.

THE OSHKOSH NORTHWESTERN TELEPHONE COMPANY, Oshkosh, Wis., capital stock $20,000, has been formed.

THE ALVARADO WATER SUPPLY & ELECTRIC COMPANY, Alvarado, Tex., capital stock $10,000, has been organized by M. Sansom, H. R. Jones, T. B. Pope, R. P. Reynolds and others.

THE SAVANNAH TELEPHONE COMPANY, Savannah, Mo., capital stock $10,000, has been incorporated by B. E. Egan, John Donald, Jr., L. N. Hooper, Jr., J. T. Hughes and J. A. McLean.

THE EGG HARBOR CITY WATER, ELECTRIC LIGHT & POWER COMPANY, Egg Harbor, N. J., has been organized. The promoters are Dr. Theo. H. Boysen, Robt. Ohnmeiss and Harry May.

THE TOLEDO TRACTION COMPANY, Toledo, O., capital stock $4,000,000, has been formed to construct, maintain and operate street railroads. Albion E. Lang, Chas. L. Wight, Winfield S. Jowell and Edgar H. Eckert.

THE PHILADELPHIA & WEST CHESTER TRACTION COMPANY, Philadelphia, Pa., capital stock $181 000, has been incorporated by W. F. B. Stewart, York, Pa.; W. C. Alderson, Overbrook; W. M. Rotch and others.

THE GRAYVILLE WATER WORKS, Chicago, Ill., capital stock $5,000, has been formed to construct water works, electric light, heat and power plants, etc. Henry A. Gardner, Livingston Griffin and Arthur M. Morgan are interested.

THE INTERSTATE LONG DISTANCE TELEPHONE COMPANY, Leavenworth, Kan., capital stock $100,000, has been incorporated by W. T. Hewitt, W. N. Todd, J. W. Folger and others to build telephone lines between Kansas towns and elsewhere.

THE CABLE INSULATOR COMPANY, Saco, Me., capital stock $10,000, has been incorporated to manufacture and deal in insulators and electrical appliances of all kinds. Sam Oakman, Wingate P. Sargent, Melrose, and James R. Powers, Boston, Mass., are interested.

THE EDDY MILLING COMPANY, Edgecomb, Me., capital stock $5,000, has been formed to establish an electric light plant, and do a milling, lumber and other business. The promoters are Willis H. Clifford, Irving E. Chase, and Fred. W. Clifford, all of N. Edgecomb, Me.

THE TOPEKA ELECTRIC RAILWAY COMPANY, Topeka, Kan., capital stock $75,000, has been formed to construct and maintain a railway from Topeka to Roseville; also street railways, etc. A. J. Arnold, T. M. James, Lewis Stair and Francis C. Downey, Topeka, are interested.

THE LA CROSSE, BLACK RIVER FALLS & MILLSVILLE ELECTRIC RAILWAY COMPANY, La Crosse, Wis., capital stock $800,000, has been formed to build an electric road from La Crosse to Millsville. The promoters are N. Clark, P. McHugh and Wm. Burns, La Crosse, Wis.

THE CLEVELAND, PAINESVILLE AND EASTERN RAILWAY COMPANY, Cleveland, O., capital stock $250,000, has been formed to construct and operate an electric railroad, furnish light, heat, power etc. H. A. Everett Julius E. French, J. A. Beidler and E. W. Moore are interested.

THE WATKINS & HAVANA RAILWAY COMPANY, Watkins, N. Y., capital stock $50,000, has been formed to build and operate a street surface electric railway five miles long. C. L. Hathaway, Horseheads; C. H. Baldwin, E. L. Adams, and C. W. Ingalls, Elmira, N. Y., are interested.

THE McKEESPORT & WEST NEWTON PASSENGER RAILWAY COMPANY, McKeesport, Pa., capital stock $60,000, has been formed to build a passenger railway operated by electricity in Westmoreland County. The promoters are Homer H. Swaney, Jos. R. Henderson and F. W. Patterson.

THE MONTCLAIR LIGHT & POWER COMPANY, Montclair, N. J., capital stock $50,000, has been formed to construct, maintain and operate an electric light and power plant in Montclair. The promoters are Geo. F. Baker, Chas. G. Coe, New York; W. C. Snow and Chas. D. Backus, Montclair, N. J.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., capital stock $50 000, has been formed to manufacture and sell electrical and mechanical apparatus and to construct telephone exchanges. Alfred Bromberg, Androv Carlson and Arthur B. Cotton are interested.

THE AMERICAN UNION TELEPHONE COMPANY, New York, maximum capital stock $5,000,000, has been formed to lease and dispose of telephones, telephone switches, electrical appliances, etc. The promoters are M. P. O'Connor and Jno. A. Wallace, of New York, and Franklin Noble, of Brooklyn.

THE INTERNATIONAL ELECTRIC FORGING COMPANY, New York, capital stock $6,000, has been formed to work metals, smelt ores and engage in business in which electricity may be used as an agent. The promoters are James Seager, J. C. Seager, New York, Lorenzo Ullo, and J. L. Ullo, Brooklyn, N. Y.

THE INTERURBAN RAPID TRANSIT COMPANY, Tiffin, O., capital stock $250 000, has been formed to construct, acquire and operate a railway or railways, to be operated by electric, steam, cable, horse, or other motive power. The promoters are M. Frost, A. Betts, Norman McCarty, Lewis Selle and W. F. Noble.

THE ELECTRIC RAILWAY.

HOUSTON, TEX.—The Rapid Transit Company will extend its trolley system to the suburbs.

DUNKIRK, N. Y.—The Dunkirk & Fredonia Street Railway Company will build a power house.

GREENVILLE, S. C.—W. A. Hudson and J. C. Smith are asking for a franchise to build an electric road in this city.

SAYVILLE, L. I., N. Y.—Surveys are being made for the construction of a trolley line from this place to Stony Brook.

DANVILLE, IND.—Danville and Hoopestown have been granted a franchise to connect the two cities by an electric road.

COHOES, N. Y.—The Troy City Railway Company has been granted permission to equip its horse railway with electricity.

WOONSOCKET, R.I.—It is reported that the Woonsocket Street Railway Company contemplates extending its tracks to Manville.

SLATERVILLE SPRINGS, N. Y.—There is a project in progress looking toward the building of an electric railway to this place.

HERKIMER, N. Y.—The roadbed is being prepared and rails laid for the new electric street railway between Herkimer, Ilion and Frankfort.

BRISTOL, PA.—The Council has passed an ordinance granting the right of way to the Newton Trolley Company through the streets of the town.

NORTH ADAMS, MASS.—The Selectmen have granted the Hoosac Valley Street Railway Company permission to extend its tracks to Williamstown.

SPRINGFIELD, MASS.—It has been stated that the street railway people will ask the city authorities for permission to extend their track toward Dalcon.

LAKE CHARLES, LA.—The Lake Charles Electric Railway Company, recently organized with a capital stock of $100,000, will build an electric railway.

KOKOMO, IND.—Capitalists of this place have secured a franchise and right of way for an electric line from Kokomo to Greentown, to be constructed this summer.

BALTIMORE, MD.—The City & Suburban Electric Railway Company will soon double track its line on North avenue from Pason to 10th streets, a distance of 1¼ miles.

CINCINNATI, O.—The Consolidated will build a line from Hyde Park to the C. H. & D. depot The road is about six miles long. John Kilgour, Fifth and Walnut streets, is president.

ALGIERS, LA.—Algiers and Gretna will be connected by an electric road. Messrs. Maas and Gerdes have secured a franchise to erect poles and string wires for electrical purposes.

MUSCATINE, IA.—The Muscatine Electric Railway Company is contemplating the enlargement of its lighting plant. General Superintendent Paul F. Seevers can furnish particulars.

SYRACUSE, N.Y.—At a meeting of the Common Council the Syracuse & East Side Railway Company petitioned for permission to construct a street railway through the various streets of the city.

YOUNGSTOWN, O.—Proposals will be received at the office of the board of city commissioners until 12 m., May 26, for the construction of street railway route No. 4. J. Howard Edwards is city clerk.

PORTLAND, CONN.—It is reported that the Portland Electric Railway Company will soon begin the construction of a road from Portland Dock to Glastonbury, to connect there with the Hartford electric road.

WACO, TEX.—The sale of the Waco Electric Railway & Light Company, popularly known as the Hudson Company, has taken place. There will be extensive improvements made in the electric lighting and street car facilities.

SAYVILLE, L. I., N.Y.—It is proposed to hold a public meeting to discuss the feasibility of securing the right of way through the village for an electric road. Civil Engineer Hawkins, of Stony Brook, will probably give information.

PIERMONT, N. Y.—The Nyack) Traction Company has made application to the board of trustees of Piermont, for permission to construct, maintain and operate along and through Piermont avenue a street surface railway to be operated by electric power.

VALPARAISO, IND.—The proposed electric railway to connect this city with Chicago is assured. The following are the officers of the company: President, A. Morrison, of Chicago; vice-president, Seward Lightner; secretary, A. J. Smith; treasurer, J. H. Roper. A franchise will be secured at the commissioners' court, June 1.

Electric Light and Power.

ALEXANDER CITY, ALA.—Steps are being taken to establish an electric plant.

CLARE, MICH.—The new electric light system is now in active and successful operation.

BIRMINGHAM, ALA.—The Consolidated Electric Light Company will erect an electric plant.

ENTERPRISE, MISS.—L. B. Bradley has been granted a franchise for an electric light plant.

PASS CHRISTIAN, MISS.—Maurice Kaufman has been granted a franchise for an electric light plant.

ALGIERS, LA.—The Algiers ice and electric plant has been purchased by Charles Carroll for $88,500.

KAUKAUNA, WIS.—The Kaukauna Electric Light Company's stockholders have applied for a receiver.

ELKINS, N. C.—Steps are being taken toward the establishment of an electric light plant. H. G. Chatham is interested.

DODGEVILLE, WIS.—The Dodgeville City Council has decided to advertise for bids for lighting the streets by electricity.

ARLINGTON, MASS.—The election held to vote on the question of establishing an electric light plant resulted unfavorably.

GLENWOOD, MINN.—The contract for an electric light plant has been let to J. R. Sarren, proprietor of the Glenwood Roller Mills.

MURFREESBORO, TENN.—A bill has been passed in the legislature authorizing the city to issue bonds for an electric light plant.

PALM BEACH, FLA.—Henry M. Flagler will erect an electric light plant to light the Hotel Poinciana and another hotel yet to be built.

MOOREHEAD, MINN.—P. H. Lamb has been awarded the contract for the building of the new electric light and waterworks station at a cost of $3,804.

BALTIMORE, MD.—A ½-hp electric motor, for either arc or 220-volt constant potential circuit, is wanted by W. E. Eberhard, Oehm's Acme Hall, Baltimore.

FLAGSTAFF, ARIZ.—J. D. Moore, of the Prescott Light & Power Company, has been canvassing the town with the view of putting in an electric light plant.

PAWTUCKET, R. I.—It is believed that the board of aldermen will oppose the plan of the Bridgemill Power Company to distribute electricity throughout the city.

PHILADELPHIA, PA.—The application of the Edison Electric Light Company for permission to lay conduits on Market, Chestnut and Walnut streets, has been granted.

HAGERSTOWN, MD.—Powell Evans, of Philadelphia, Pa., has made application to the City Council for authority to erect poles in Hagerstown for an electric power system.

PAWTUCKET, R. I.—At a meeting of the board of aldermen an application was received from Darius L. Goff and Lyman B. Goff, of the Bridge Mill Power Company, for permission to distribute electricity for general purposes throughout the city.

EVANSVILLE, IND.—Sealed proposals will be received by the board of public works on June 15, for lighting the streets and public places of the city with electricity for a period of five years. There will be 400 lamps of 2,000 candle-power each.

ASBURY PARK, N. J.—Proposals for lighting this town by electricity will be received until 12 m., June 3, by Wm. C Burrows, clerk. The bids to be for 25 arc lamps of 2,000 candle-power, with the privilege to the borough of additional lamps, if desired.

NEWTOWN, L. I., N. Y—The contract for lighting the town has been let to the Long Island City Electric Illuminating Company, whose bid was $127 75 per lamp per year. The contract for lighting the town with gas was let to the Newtown Gas Company.

ELK POINT, S. DAK.—C. L. Potter, of the firm of B. N. Potter & Co., of New York, has proposed to the city that if it will grant a 50-year franchise and will agree to pay for all water used, he will put in an electric and water works plant to cost $80,000.

MACKINAC ISLAND, MICH.—The City Council of Mackinac Island has granted to J. F. Knightsley, of Jackson, a 30 year franchise for furnishing an electric lighting plant, from June 1, 1896. The plant will include both arc and incandescent lights.

HAGERSTOWN, MD.—The William Wharton, Jr., Company, of Philadelphia, Pa., has been granted the privilege to erect an electric plant on the canal of the Chesapeake & Ohio Canal Company. It proposes to furnish the factories at Hagerstown with electric power.

PAWNEE CITY, NEB.—Sealed bids will be received by the City Council until May 27, for one high, low, or medium speed high pressure engine of 80 to 100 horse-power with one feed water heater of suitable capacity, and one 500 or 600-light incandescent dynamo, with necessary switches, voltmeters, amperemeters and other requisite equipment. G. Humphrey can give further details.

Telegraph and Telephone.

MANCHESTER, IA.—The Manchester telephone system is expected to be in operation shortly.

GARRETSVILLE, O.—F. B. Hopkins has been granted a franchise for telephone exchanges at this place for 10 years.

COLUMBUS, O.—The Ohio Telephone Exchange Company has announced its intention to cut the prices of the old companies about 50 per cent.

LOS ANGELES, CAL.—C. W. Hinchliffe, assistant superintendendent of the Sunset Telephone Company, has filed plans for the city clerk, showing the proposed location of an extension of the company's underground system.

MADISON, WIS.—The United States patents covering the Milne telephone system have passed into the control of a company headed by Madison capitalists, the principal of whom are H. L. Spooner, president; B. B. Clarke, vice-president; E. W. Batchelder, secretary; and B. M. Lamp, treasurer.

CAPE MAY, N. J.—The City Council has passed an ordinance granting the right of operating in the city to the Telephone Company of South Jersey, and has also passed through second reading ordinances granting franchises to the Postal Telegraph & Cable Company and the Cape May City Electric Light & Power Company.

Personal Note.

PROF. J. J. FLATHER, of Purdue University, was in Lexington, Ky., last week, where he delivered a lecture on "Rope Driving" before the engineering students of the State College. The lecture was illustrated with numerous lantern slides and proved a most interesting subject.

Miscellaneous Notes.

WASHINGTON AND LEE UNIVERSITY has decided to abolish the degree of civil engineering and substitute therefor the degree of bachelor of science, which will be conferred in three courses, those of civil engineering, electrical engineering and mining engineering.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY announces a supplementary summer course to be given during June and July. The courses are to be seven in number, viz. I. Mechanical Drawing and Descriptive Geometry; II. Mathematics; III. Architecture; IV. Chemistry; V. Biology; VI. Physics; VII. Modern Languages. Entrance examinations for the regular winter course will be held at the Roges Building, 491 Boylston street, Boston, on June 27 and 28, and Sept. 24 and 25. For the convenience of applicants outside of New England the June examinations will also be held in 18 cities widely separated. Full information is given in pamphlets which the Institute is distributing.

THE BROOKLYN ELECTRICAL SOCIETY on May 24 listened to an interesting lecture on the subject of "Induction," delivered by Mr. Nelson W. Perry. Mr.

Perry made use of some very effective similes in explaining to his audience inductive effects. He called attention to the analogy between the phenomena of induction by ethereal waves and the transmission of energy by the liquid waves when a stone is cast in the water, and illustrated the action of lines of force about a conductor carrying alternating currents by the spring on the balance wheel of a watch which continually contracts and expands. The lecture closed with an exhibition of the operation of Dr. Lodge's coherer, by which ethereal waves were caused to close a circuit and ring an electric bell. After Mr. Perry's lecture Mr. Durant exhibited a number of Geissler tubes in which light effects produced by induction were very prettily shown.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its annual meeting for the election of officers and the reception of the Council's and Treasurer's reports at 12 West 31st street, on Tuesday evening, May 21, at 8 p.m., being the third Tuesday in the month as fixed by the rules. In accordance with a vote at the meeting of April 17, the discussion of Prof. Anthony's paper on "Underwriters' Rules" will be resumed. It will be opened by Prof. Wm. L. Puffer, of the Massachusetts Institute of Technology, Consulting Electrical Engineer of the Associated Factory Mutual Insurance Companies. This meeting should not be confounded with the general meeting to be held at Niagara Falls in June. The Council will meet in the office of the Institute, 26 Cortlandt street, Tuesday May 21, at 4 p. m. Non-members receiving a notice are cordially invited to attend the meeting. On account of some uncertainty as to the arrangement at Niagara Falls, a committee has been appointed by Council with power to postpone the general meeting if necessary to a date no later than July 1. Due notice will be given of any action taken.

Trade and Industrial Notes.

J. H. BUNNELL & CO. 76 Cortlandt street, New York, have been granted a patent upon their aluminum-lever telegraph sounder recently illustrated in our columns.

THE LAW BATTERY COMPANY has removed its offices to 39 Cortlandt Street, New York. The company has equipped a large new factory at Cranford, N. J., and is making preparations to greatly extend its business.

THE KNAPP & ELECTRIC NOVELTY COMPANY, 47 Warren Street, New York, reports a surprisingly good business in its battery fan outfits, an indication that people appreciate a good article and are willing to pay a fair price for it.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, is receiving a large number of inquiries regarding the new Meston alternating current ceiling fan, which promises to find fully as useful, if not as large a field, as the regular Meston desk fan.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth avenue, Chicago, furnished the lamps for the large spiral tower of A. M. Rothschild & Co.'s new store. This tower has created a sensation in Chicago and the Metropolitan Company feels that it has "scored a hit" by having its lamps selected after other lamps had failed.

THE ALLEGEMEINE ELEKTRICITATS GESELLSCHAFT, of Berlin, Germany, has issued a large, handsomely illustrated catalogue of its trolley system, embracing everything from the generator to the track, inclusive. The system does not materially differ from the best American practice. The catalogue is printed in English.

CHAS. A. SCHIEREN & CO., 47 Ferry street, New York, report that their factory is running full time and is considerably behind orders. The firm attributes the increasing demand for its belting to the fact that all the tanning is done by slow process and with pure oak bark, which results in giving the leather the greatest durability.

BALSLEY & BRYNER, of Connellsville, Pa., are putting on the market a very meritorious insulated socket. A notable feature of the device is the location of the key and switch in the barrel of the socket, so that when the two parts are separated the cap or base contains only the two terminal pieces, greatly facilitating the work of "wiring up" the socket.

SMETHURST & ALLEN is the style of a new electrical engineering firm whose headquarters are in the Betz Building, Philadelphia. Mr. Smethurst was formerly with Pepper & Register, and has had an extensive experience in practical engineering. Mr. Allen was previously connected with the Philadelphia Traction Company. The firm has recently been awarded an important contract by the New York & Philadelphia Traction Company.

THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, Ind., in an exceedingly tasteful new catalogue, describes at length, and with the aid of numerous illustrations, its line of dynamos and motors. The small sizes are made in bipolar form, the larger ones being furnished in both bipolar and multipolar designs according to the service required. The company is making a specialty of multipolar slow-speed dynamos, either belt-driven or direct-connected.

THE C. W. HUNT COMPANY, 45 Broadway, New York City, has recently furnished the Schoen Manufacturing Company, of Pittsburgh, Pa., with a complete industrial narrow gauge railway system, comprising track and cars. The Hunt Company has issued a 40-page catalogue descriptive of its industrial railway system, which embraces special cars of every conceivable description, standard dumping cars, flat cars, tip cars, sectional track, switches, turntables, etc.

J. E. PUTNAM & CO., of Rochester, N. Y., have just completed the electrical work in the new Chamber of Commerce Building in that city. The equipment includes two Western Electric 50-kw multipolar generators connected direct to Ames automatic engines. Three thousand incandescent lamps are wired up, brass armored conduit being used throughout. The switchboards are five panel, marble, and the feeders are so arranged that they may be supplied from the local Edison mains if desired. There are also two Blackman ventilating fans, 36-inch and 60-inch, driven by Lundell motors, and about 25 arc lights.

THE INTERIOR CONDUIT & INSULATION COMPANY, 527 West 34th street, New York, found that the hot spell made business lively in one department of the electrical supply trade. Mr. E. W. Little, the general manager, reports that the sudden advent of midsummer created a boom of no small proportions in the sale of Lundell fan motors. The Pettingell-Andrews Company, New England agent for the Interior Conduit Company, reports sales aggregating $4,000 in one day recently, and the orders from the Central Electric Company, of Chicago, have alone been enough to keep a good-sized factory busy. Sales of the Lundell fan motors in other parts of the country are reported to be quite large and much in excess of the figures reached this time last year.

H. E. COLLINS & CO., Bank of Commerce Building, Pittsburgh, sole sales agents for the United States and Cuba for the Cahall Vertical Water Tube Boiler, manufactured by the Aultman & Taylor Machinery Company, of Mansfield, Ohio, have within the past month closed contracts with the Salem Iron Company at Leetonia for 250 horse-power for their blast furnaces; Ætna Standard Iron & Steel Company, Bridgeport, Ohio, 100 horse-power; Brown-Bonnell & Co., Youngstown, Ohio, 324 horse-power; Carrie Furnaces, Pittsburgh, Pa., 2,000 horse-power; Canonsburg Iron & Steel Company, Canonsburg, Pa., 250 horse-power boilers. The orders from the Salem Iron Company, Ætna Standard Iron & Steel Company and Brown-Bonnell & Co., are repeated orders from these concerns. The boilers for the Salem Iron Company and Carrie Furnace Company are both for burning blast furnace gases and the boilers for the Canonsburg Iron & Steel Company are for utilizing waste heats from heating furnaces.

THE BALL ENGINE COMPANY'S WORKS, at Erie, Pa., are unusually busy just now, the erecting floors being crowded with engines in process of construction. Especially noticeable, by their appearance, among the many engines are three of 175 horse-power each, adapted for direct connection to Mather dynamos, which are to go to the new library of Congress, Washington, D. C., in a few days. These engines are painted pure white, according to the instructions of the government, and with their polished brass fittings certainly present a handsome appearance. Among other engines in process of erection are two 125-hp tandem compounds for the Norfolk & Ocean View Railway Company, Norfolk, Va.; one 300-hp tandem compound railway engine for the Rock Creek Railway Company, Washington, D. C.; one 400-hp vertical cross compound engine for the Camden Horse Railway, Camden, N. J.; two 160-hp tandem compounds for the Salamanca Water Works, Salamanca, N. Y.; one 175-hp for the Suburban Traction Company, Orange, N. J., and one 100-hp vertical engine for the Detroit *Free Press*, Detroit, Mich.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 14, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

539,024. ELECTRICAL CONNECTOR; F. N. Bell, Milford, Mass. App. filed July 28, 1894. The combination of an outer thimble having one end closed near a centrally located bolt hole, the walls of the thimble being split in the direction of the length and an inner sleeve, having a tapering surface adapted to expand the outer thimble upon being subjected to pressure from a screw bolt, connecting with a rod passing through the thimble and sleeve.

539,032. CARBON BRUSH HOLDER FOR DYNAMOS; W. S. Bosley, Chicago, Ill. App. filed Sept. 8, 1894. The combination of a bar with its end upturned, a clamping plate secured by one end to the bar, a carbon block adapted to rest between the upturned end and the elevated end of the clamping plate, the clamping plate having a screw to move the plate either toward or from the bar to hold or release the carbon block.

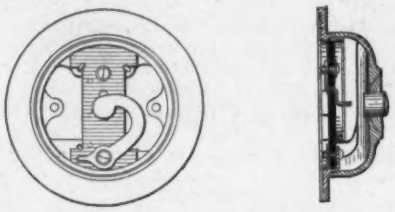
39,040. INSULATOR; L. H. Desisles, Boston, Mass. App. filed Sept. 10, 1894. The combination of a main block having end brackets, a metallic clip, and a holding screw; the screw and clip having screw thread connections with each other and co-operating in a bracket to hold a wire.

539,068. TELEPHONE; M. Martin, Malden, Mass. App. filed Nov. 10, 1886. The combination of a diaphragm or vibrating piece of magnetic material having a central opening, with a magnet having a pole piece terminating opposite the said opening, whereby the attractive force of the magnet acts mainly in the direction of the plane of the diaphragm.

539,079. ELECTRIC PUSH BUTTON; A. J. Gehring, Chicago, Ill. App. filed Nov. 2, 1893. The combination of a base of yielding material having projecting pins or studs formed integral therewith, and a switch plate thoroughly insulated, secured to the base by bending the said studs down upon it.

539,086. TELEPHONE TRANSMITTER; R. F. Rice, Hartford, Conn. App. filed May 18, 1893. The combination of a diaphragm of an undulator consisting of a multiplicity of surface contacting members under successively increased loads, and comprising single part and multi part members in alternating succession.

539,099. ANNUNCIATOR CONNECTION FOR MULTIPLE SWITCHBOARDS; G. Tainor, Keene, N. H. App. filed April 11, 1892. An annunciator included in a telephone series, a normally open circuit about said annunciator, and means for closing the said circuit by the act of making connection with the line.



No. 539,079.—Electric Push Button.

539,105. VARIABLE RHEOSTAT; E. P. Warner, Chicago, Ill. App. filed Sept. 18, 1894. The combination of bare resistance wires constituting the winding, with a contact device adapted to travel over said wires, the contact device being provided with contact rollers which are adapted to bear upon a number of the convolutions of the winding at the same time.

539,142. TELEPHONE CIRCUIT AND APPARATUS; C. W. McDaniel, Kansas City, Mo. App. filed March 16, 1895. A telephone circuit extending through a plurality of way stations, in series, in each of which the circuit passes through two double spring jacks beween which branches extend from each circuit conductor to a high resistance call bell in a permanent bridge, and other branches extending from the said conductors to the open terminals of a conducting plug, whereby when the said plug is inserted into one of said jacks the circuit conductors are opened at the said jack and transferred through the said plug terminals to the other jack, a new circuit through the way stations being established through the telephone switch.

539,150. ELECTRIC LAMP; W. H. Sheppard, New York, N. Y. App. filed Nov. 20, 1894. An incandescent lamp socket having bracket arms secured thereto, the arms swinging or not as desired, and secured at their lower end a shade and support for an electric lamp, the wires being led through one of the brackets.

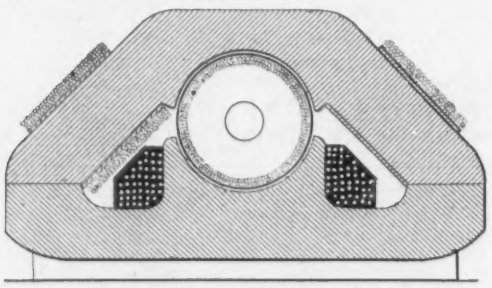
539,154. RAILWAY SIGNAL SYSTEM; G. L. Thomas, Brooklyn, N. Y. App. filed Jan. 28, 1895. A system having a series of signals arranged along a track, a train moving along the track to control the signals, the electric circuits being arranged to hold the signals at danger and a device to prevent a plurality of signals both before and after a train being turned to safety by an approaching train when the track is not clear.

539,163. TELEPHONE TRANSMITTER; A. C. Brown, London, Eng. App. filed Sept. 27, 1894. The combination of a diaphragm, a back electrode, a mass of granulated material being between the two, a rigid ring seating on one side of the diaphragm, and an elastic support on the other side acting to press the diaphragm toward the granulated material and compressed to a predetermined weighed pressure and permanently fixed independent of the weighed pressure.

539,170. MAGNETIC CALL APPARATUS; F. B. Cook, Chicago, Ill. App. filed Dec. 26, 1894. The combination of a telephone circuit having magneto call generator normally connected therein, but shunted from the main circuit; generator actuating mechanism, an automatic switch, and means for withdrawing the generator from the shunts.

539,184. CLOSED CONDUIT ELECTRIC RAILWAY; P. Lucas, Berlin, Germany. App. filed June 23, 1894. The combination of a casing containing a series of stationary contacts, a conductor, levers arranged to be rocked by the car, and supplemental levers pivoted to the said levers carrying contact plates; electrical connections from the plates to the stationary contacts, and switches within the casing having arms extending outside the casing.

539,192. ELECTRIC LIGHT HEAD GEAR FOR PERSONAL WEAR; A. M. Rodriguez and E. D. Rockwell, Brooklyn, N. Y. App. filed Feb. 25, 1895. The combination of wires located in a cap with contacts attached thereto, and a lamp; the lamp to be worn on a cap or hat.



No. 539,277.—Electric Motor.

539,216. RHEOSTAT; A. C. Carey, Lake Pleasant, Mass. App. filed Feb. 26, 1895. A rheostat having a central tube with heads mounted on each end, having conductors leading through the centre, refractory and insulating linings for the adjacent faces of said heads, contacts applied to such linings, a rotary spool arranged upon the heads, a series of layers of wire insulated from each other, and contacts for including such layers of wire in the main circuit.

539,222. ELECTRIC CONDUCTOR; J. R. Hare, Baltimore, Md. App. filed Nov. 23, 1894. An electric conductor formed in separated sections, which are electrically connected by rods which project from side to side.

539,234. ELECTRIC FIRE AND WATER ALARM; G.S. Neu, New York, N. Y. App. filed Jan. 25, 1895. An alarm having a device to be released by heat and water, and provided with a spring actuated plunger, a soluble button, a fuse and electrical contacts kept normally apart by the fuse and button.

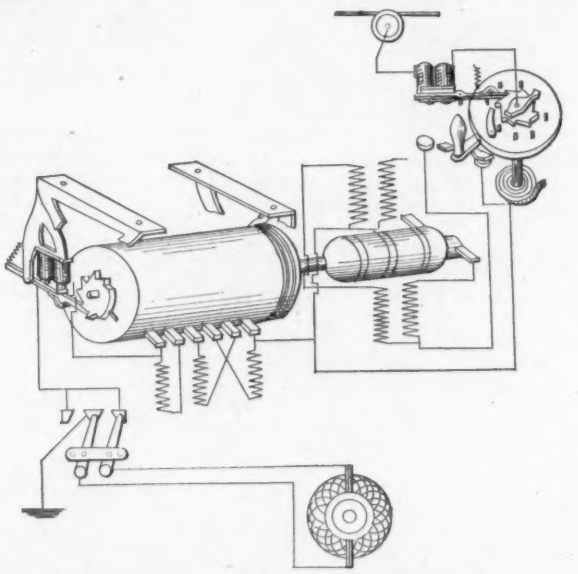
539,274. MOUNTING FOR TELEPHONES; T. Kelly, Philadelphia, Pa. App. filed Sept. 8, 1894. The combination of a telephone receiver and transmitter with a plate carrying the same, fastenings whereby said plate is secured to the wall of the room, and distance pieces serving to prevent contact of the plate with the wall.

539,277. ELECTRIC MOTOR; J. C. Lincoln, Rochester, N. Y. App. filed Jan. 16, 1892. The combination of shunt field magnet windings connected in series across the main line, an armature and a series coil partially surrounding the armature and directly magnetizing it; the series coil and armature being connected in series with each other across the main line.

539,293. CONTROLLER FOR ELECTRIC MOTORS; H. F. Parshall and J. W. Darley, Jr., Lynn, Mass. App. filed Feb 11, 1893. The combination, with a controller cylinder for an electric motor, of an electric motor for actuating said cylinder, and means for returning it to its normal position when the current is broken.

539,298. COMMUNICATING, SIGNALING, ETC., TO OR FROM MOVABLE OBJECTS; J. Y. Porter, Cleveland, O. App. filed Feb. 14, 1894. A trolley wire having a pivoted conductor and a depending portion thereof extending below such wire, the same being free to swing across the vertical plane of the trolley wire without engagement therewith.

539,304. SIGNALING SYSTEM; John P. Coleman, Swissvale, Pa. App. filed Aug 26, 1893. In a signaling system, the combination of signal operating mechanism, an electrically controlled lock for such mechanism, a circuit for the lock, a make and break mechanism arranged in the circuit, an electrically controlled indicating device for operating the make and break mechanism, a circuit for said indicating device extending to the next succeeding station, and a make and break mechanism in the circuit at such station.



No. 539,293.—Controller for Electric Motors.

539,365. ELECTRIC ARC LAMP CLUTCH; W. B. Luce, Brookline, Mass. App. filed March 15, 1894. A clutch consisting of a clutch ring or plate, composed of an inner ring or plate, a ring or plate of insulating material and an outer plate or ring.

539,369. MEANS FOR EFFECTING SYNCHRONISM; J. H. Rodgers, Washington, D. C. App. filed Dec. 29, 1888. The combination of two mechanically disconnected motors—contact makers operated thereby, one member of each contact maker being stationary and the other revolved by its motor—an electric circuit periodically closed by one contact maker, and means for shifting the stationary member of the other contact maker when synchronism fails.

539,376. STARTING BOX FOR ELECTRIC MOTORS; D. M. Bliss, Boston, Mass. App. filed Feb. 20, 1895. A rheostat comprising contacts successively connected with a series resistance, a movable switch member adapted to co-operate with said contacts, an armature co-operating with the switch, and a stationary electro-magnet having its entire polar face adjacent to the path of movement of said armature, whereby the said armature and switch may be locked by the attraction of said magnet in any position.

539,392. ARC LAMP; C. A. Pfluger, Chicago, Ill. App. filed April 5, 1894. The combination of two electrodes each having two carbons adapted to be fed toward each other at an acute angle, means for moving the upper carbons simultaneously to establish the arc, and a device for feeding the lower carbons comprising a weight, a rod upon which said weight is adapted to slide, and cords connecting said weight and said carbons passing in opposite directions over two pulleys.

539,393. ELECTRIC ARC LAMP; C. A. Pfluger, Chicago, Ill. App. filed July 2, 1894. Substantially the same as above.

539,396. RAILWAY SIGNAL; J. Stringham, Jersey City, N. J. App. filed Feb. 6, 1895. An apparatus having a signal set at danger by the passage of a train into a guarded section, a releasing circuit for setting the signal at safety, a circuit controller for the releasing circuit, and electrical connections with the track preventing actuating of said circuit controller until the rails are bridged at a plurality of points before the signal is reached by the train.